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and Programmatic Support  
Contract No. NAS5-32490**

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**Technical Report**

**for**

**October 1, 1993 through December 31, 1993**

**NASA/Goddard Space Flight Center  
Contracts Office  
Mail Code 286  
Greenbelt, Maryland 20771**

**by**

**Universities Space Research Association  
Mail Code 610.3  
Building #26, Room 215  
NASA/Goddard Space Flight Center  
Greenbelt, Maryland 20771**





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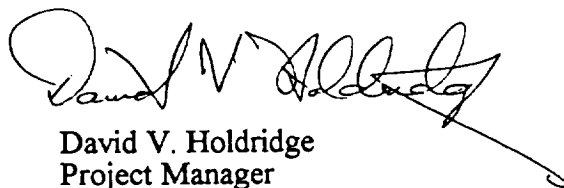
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Enclosed is a copy(ies) of the Technical Report for the USRA/Goddard Visiting Scientists Program under contract NAS5-32490 for the period of October 1, 1993 through December 31, 1993.

If you have any questions, please don't hesitate to contact us.



David V. Holdridge  
Project Manager



**February 8, 1994  
Contract No. NAS5-32490  
Technical Reports  
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**High Energy Astrophysics Research  
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Contract No. NAS5-32490**

**Technical Report**

**for**

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**Brief Summary of Task Activities under Contract NAS5-32490 During the Period of  
October 1, 1993 through December 31, 1993**

**(Individual Project Reports are attached on the indicated pages)**

**Summary notation and actual reports are sequentially listed by Task Number**

**SPACE SCIENCES**

<b><u>Page #</u></b>	<b><u>Task Number</u></b>	
<b>1</b>	<b><u>93-01-00</u></b>	<b>Drake</b> continued to co-ordinate the transfer of the HEASARC's database access system XOBSEVER/BROWSE from a VMS-system on NDADSA to the Ultrix-based LEGACY computer. He also continued to oversee the development and maintenance of the anonymous ftp area on HEASARC's LEGACY computer. Dr. Drake wrote two articles to be included in the next issue of the Legacy Journal.
<b>10</b>		<b>George</b> proceeded with the maintenance and development of the OGIP Calibration Database, an on line database designed to contain calibration files for all instruments for which the OGIP is responsible for supplying scientific data. He also contributed to the further development of calibration software tasks under the FTOOLS umbrella.
<b>16</b>		<b>Whitlock</b> provided user support for the on-line Vela 5B and HEAO1 databases and completed the Vela5 Calibration/User's Guide. She also organized a committee and began to develop a "standard" for putting all-sky scanning satellite data into FITS format. In addition, Dr. Whitlock has written two articles for the next issue of the Legacy Journal.
<b>18</b>	<b><u>93-02-00</u></b>	<b>Corcoran</b> supervised the data ingest process into the ROSAT public archive and gave presentations regarding the status of the ROSAT archive to both the 5th HEASARC and ROSAT User's Group Meetings. In addition, he received and answered archive related questions for approximately 120 people throughout the quarter.
<b>26</b>		<b>Schlegel</b> researched upper limits on x-ray emissions and the $\gamma$ -ray emission from cataclysmic variables. A paper is nearing its completion. A bulk of this quarter has been spent making preparations and holding the ROSAT Science Symposium. Approximately 130 people attended this 3 day meeting.
<b>29</b>		<b>Snowden</b> completed the final processing of the cosmic diffuse background data from the ROSAT all-sky survey. He also met with participants of MPE, GSFC, CfA and Leicester to discuss the calibration status of the PSPC and HRI and to outline procedures for improvements. Dr. Snowden has had one paper published and another accepted for publication.

- 30                    **Turner** began to compile all available ROSAT PSPC information into a PSPC "Calibration Guide". In addition, she attended the ROSAT calibration workshop, where scientific results from ROSAT data were shown and data analysis techniques discussed. Dr. Turner has had two papers published.
- 32            93-03-00       **Ebisawa** participated in the ASCA Software/Science Meeting and subsequently worked on the development of the ASCA data analysis system. He completed work on GX339-4 energy spectra and worked on the Ginga observation data of the bright x-ray nova GS1124-68, as well.
- 33                    **Mukai** installed the new version of the ASCA FTOOLS/XSELECT software, performed an end-to-end test of the analysis system and helped our Japanese colleagues use them. In addition, Dr. Mukai spent most of this quarter concentrating on the ASCA PV phase observations and submitted a related paper for publication.
- 34            93-04-00       **Smale** has been leading the FTOOLS effort within the XTE project and chaired the search committee for the fourth XTE scientist, who will be taking the main role in the proposal management and calibration arenas. Dr. Smale was also involved in the analysis of the data from the observations of X1916-053.
- 37                    **Rots** worked on the Build 2 software delivery and completed the design of the Data Description Language (DDL). He also assisted the Instrument Teams in understanding the DDL and its requirements. Dr. Rots also submitted a proposal for an ADS grant with Co-I's P. Barrett, E. Schlegel and A. Smale.
- 39            93-05-00       **Giles** continued as the Software Manager for the PCA experiment software development and deliveries to the XTE Science Operations Center. He also continued to support the Goddard team, developing the PCA detectors for the XTE satellite. In addition, he has updated and/or enhanced four separate documents to date and is near completion on a draft paper for submission regarding the Rapid Variability Analysis.
- 41                    **Zhang** cooperatively worked on the XTE/PCA detectors evaluation, test and calibration activities. He also assisted in determining and resolving two problems that arose earlier this year for this project. Dr. Zhang report the group's progress on the PCA instruments at the XTE Science Working Group.
- 42            93-07-00       **Christian** continued his work on four balloon and balloon-borne experiments: ALICE (A Large Isotopic Composition Experiment), IMAX (Isotope Matter-Anti-matter eXperiment), the TIGER (Trans-Iron Galactic Element Recorder) and the ISOMAX. He also continued to work on a paper regarding the Voyager Cosmic Ray System.

- 45      93-09-00      Barthelmy was appointed "Lead Instrument Scientist" for the GRIS project and began the post-flight analysis. He was also involved in the explosions in effort, interaction, activity and scope of the BACODINE project and had his GRB follow-up proposal accepted.
- 48      93-10-00      Seifert led the Transient Gamma-Ray Spectrometer (TGRS) data analysis and Ground Support Equipment software development and worked on designing and testing the algorithms which are being used by the software. He also was responsible for 1) writing the software requirement/ specifications and documentation and 2) for formulating/conducting all the instrument tests and calibrations during the integration/calibration phase of TGRS.
- 50      93-11-00      Mitchell worked on developmental activities for the new ISOMAX balloon program and analyzed the 1992 IMAX flight. He also made preparations for the WiZard 1994 balloon campaign and conducted an experimental run of the E878 experiment. Dr. Mitchell worked on a number of new and ongoing projects as well, such as the TIGER, H0, POEMS, new satellite experiments, and the next generation High-energy Gamma Ray Telescopes.
- 54      93-14-00      Soong submitted a proposal for the center DDF funding as Co-I and was granted a one year extension on the original proposal of fabricating x-ray reflecting mirrors via surface replication. He also continued his work on the Galactic binary x-ray emitters.
- 55      93-15-00      Yaqoob continued his ASCA observations of the two high redshift quasars, the PKS 0438-436 and the PKS 2126-158. He also worked on the x-ray emission of 3C 273 as well as the Seyfert II Galaxy MKN 3, both observed with ASCA. Dr. Yaqoob had two papers published in the *Astrophysical Journal*.
- 57      93-17-00      Loewenstein spent a great deal of time and effort to place the x-ray microcalorimeter on board the next Japanese x-ray satellite, working up feasibility studies and simulations prior to the ISAS meeting. He continued to analyze the ROSAT observations of low luminosity early type galaxies. Also, Dr. Loewenstein is co-authoring an ASCA paper to be published in the *Proceedings of the Astronomical Society of Japan*.
- 58      93-18-00      Black led the group from Goddard that delivered the MOXE engineering model to IKI for acceptance testing and made preparations for MOXE project's actual delivery and testing. Dr. Black also gave a presentation on the MOXE for the Director of Goddard and to a reporter from *Space News*. Dr. Black terminated employment with USRA effective December 15, 1993.

Hubeny continued his work on non-LTE model stellar atmospheres including effects of millions of spectral lines, performing a number of tests and have several papers accepted for publication regarding this field. He also continued the long-term project of developing a universal spectrum synthesis program for binary stars and researched models of accretion disks and white dwarfs found in some selected cataclysmic binary systems.

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1993 October 1st - December 31st

WORK ACCOMPLISHED AND IN PROGRESS

(1) General HEASARC Support

I continued to co-ordinate the transfer of the HEASARC's database access system XOBSEVER/BROWSE from a VMS-system on NDADSA to the Ultrix-based LEGACY computer, as well as the transfer and/or FITSification, if necessary, of the data files. As of the end of the quarter, most of the BROWSE bugs had been identified and corrected, and most of the data files had been transferred, with the exception of the EXOSAT data products, for which FITS file formats were still being finalized.

I continued to oversee the development and maintenance of the anonymous ftp area on HEASARC's LEGACY computer. New datasets added this quarter included:

- (i) the 647 Mbytes contents of the NRAO CD-ROM 'Images from the Radio Universe' which were stored in a new ftp directory called nrao. As part of this process, I had to rename all of the files to unix-style names, e.g., 1800m30.fits, from their original VMS-style names, e.g., 1800M30.;1.
- (ii) the 838 Mbytes of the first 2 CD-ROM's of the IRAS Sky Survey Atlas which were stored in a new ftp directory called iras.
- (iii) an IDL interface to the Raymond and Smith Plasma Code (in /software/plasma\_codes/raymond).

I also extensively revised (i) the Einstein subdirectory that contains data from the Focal Plane Crystal Spectrometer (FPCS): I renamed many of the files so that they followed a rational and consistent naming convention and I created a file that contained a table which listed all of the fpcs files and the correlations between the lightcurve and the spectral files, and (ii) the HEAO-1 directory that contains data that we obtained from a tape provided by John Nousek of Penn State University: Some of the files were found to be corrupted and required substantial editing to clean them up.

I wrote 2 articles for the next issue of the Legacy journal: one on the 'new' ways of accessing our database, such as the World Wide Web/Mosaic and Gopher, and the other on the upcoming transfer of our main archive from the VMS-based computer NDADS to the Ultrix-based computer LEGACY, and its implications and affects on the users of our services.

I took over oversight of the HEASARC Astrophysics Data System (ADS) node from Dr. Paul Barrett

The SSS FITS files formats were submitted to the OGIP FITS Panel for their evaluation and input on their conformity to the High-Energy Astrophysics FITS standards that they have/are developing.

(2) Miscellaneous Activities Including Science Research

I received the final ROSAT data on Magnetic Bp stars that had been obtained as part of an AO4 Guest Investigator Program of which I was a Co-Investigator. The star with the biggest known magnetic field of any of this class, Babcock's Star or HD 215441, turned out to be a weak X-ray source: at its large distance of 800 parsecs, the implied X-ray

luminosity of  $10^{30}$  erg/sec is quite respectable, however. Final analysis of these data will commence in 1994.

I attended the First Annual ROSAT Science Symposium and Data Analysis Workshop held in College Park, MD from November 8 through 10, 1993. I presented a poster paper in collaboration with Nick White (GSFC) and Alan Smale (USRA), among others, that discussed (a) the analysis of the Einstein SSS, BBXRT, and ROSAT PSPC spectra that have been obtained of the prototype semi-detached binary system Algol, and (b) the analysis of PSPC spectra of several other Algol-type binary systems. This paper presented some interesting new results: (i) evidence for variable and phase-dependent circumstellar absorption in Algol, except near phase 0.0 when the K star believed to be the X-ray emitting source is in front of the other component, and (ii) evidence from the PSPC spectra for a soft component with a temperature of order 1 MK, in addition to the previously known components at a few and 20 MK, in Algol and all but one of the other similar binaries. I wrote up a 3-page contributed paper summarizing the poster that will appear in the published proceedings of this workshop. [See appended preprint].

The paper on the re-analysis of the existing Solid State Spectrometer (SSS) and Transmission Grating Spectrometer (TGS) spectra of the active binary star Capella, written by myself, Nicholas White (OGIP), and Jelle Kaastra and Rolf Mewe (SRON, Holland), was still being revised at the end of September and should be submitted to Astrophysical Journal early in 1994.

I refereed a chapter of a book on Stellar Winds/Cosmic Rays Interactions that is to be published by the University of Arizona Press. In addition, I was asked to be a referee of proposals to observe stars using one of the national radio astronomy facilities, for the 3-year period commencing January 1st 1994. After some soul-searching, I agreed to this request.

#### NON-LOCAL TRAVEL

I attended the 8th Cambridge Cool Stars Workshop held in Athens, GA from October 11th through 14th 1993, and presented a poster paper describing the results of a radio survey of an X-ray selected sample of putative active stars. This demonstrated (I hope) that a short radio follow-up observation can confirm or refute the association of an observed X-ray source with a proposed late-type stellar counterpart in a high percentage of cases (84% in the case of a sample of 32 IPC Slew Survey X-ray sources). I wrote up a 3-page contributed paper summarizing the poster that will appear in the published proceedings of this workshop. [See appended preprint].

#### WORK PLANNED FOR NEXT QUARTER

I will oversee the creation of a new independent and complete Einstein Monitor Proportional Counter (MPC) database to replace the version presently in the HEASARC database that contains only a small fraction of the available MPC data.

I will oversee the FITSification of the SSS database and the creation of software tools to analyze said data after the verification of the accuracy of the data stored in the FITS files is completed.

I will continue overseeing the anonymous ftp account on HEASARC's

LEGACY computer, as well as the HEASARC's ADS node.

I will submit the Capella SSS and TGS paper discussed above to the Astrophysical Journal.

## AN X-RAY SPECTRAL STUDY OF ALGOL BINARY SYSTEMS

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### ABSTRACT

The X-ray spectra of  $\beta$  Per (Algol), obtained by the *Einstein* Solid State Spectrometer (SSS), the Broad-Band X-ray Telescope (BBXRT), and the *ROSAT* PSPC, at a variety of epochs and orbital phases, are discussed, as well as new PSPC spectra of several other Algol systems. The spectra of  $\beta$  Per show evidence for anomalous, presumably circumstellar absorption at certain orbital phases, while the PSPC spectra of all 4 systems exhibit a soft thermal component with  $T \sim 0.1 - 0.2$  keV.

### 1. Introduction

Algol binaries that are cool enough to contain a star with a convective envelope are an important class of coronally active objects. The prototype Algol ( $\beta$  Per) has a quiescent X-ray luminosity of  $\sim 5 \times 10^{30}$  erg/s and exhibits X-ray flares lasting several hours in which the luminosity can increase by up to a factor of ten (White *et al.* 1986). The *Einstein* SSS spectra of Algol are well fit by a two-component thermal plasma model with temperatures of  $\sim 0.6$  and  $\sim 2 - 3$  keV that is similar to that inferred from the SSS spectra of RS CVn binaries (White *et al.* 1980, Swank *et al.* 1981). This similarity suggests that the X-rays are produced by a corona surrounding the K star component in this system, rather than, for example, shock heated gas from the collision of the gas stream with the BS star primary component.

An X-ray survey of 9 Algols was made by White and Marshall (1983) using the *Einstein* IPC; they concluded that these systems show the same correlation of X-ray luminosity with rotation velocity that 'normal' coronal stars exhibit, but that, compared to the RS CVn systems, the X-ray luminosity of an Algol of the same orbital period is lower. White and Marshall suggested that, for RS CVn systems, the magnetic loop interactions between the two late-type components provide a larger magnetic volume to contain the X-ray emitting plasma than in Algol binaries, where such magnetic loop interactions should not occur.

We present here a preliminary analysis of recent PSPC observations of the prototype  $\beta$  Per (for which there is a very high-quality spectrum totalling

$\sim 52,000$  counts), and of 3 other Algols (U Cep, RZ Cas, and TW Dra). We also discuss high-resolution BBXRT and SSS spectra of  $\beta$  Per that cover a rather harder energy range ( $\sim 0.4 - 10$  keV) than the PSPC ( $\sim 0.2 - 2.5$  keV).

## 2. Discussion

The most striking new result is that  $\beta$  Per shows evidence at certain orbital phases ( $\Phi = 0.2, 0.6, 0.9$ ) for an absorption column of  $n_H \sim 5 - 8 \times 10^{20} \text{ cm}^2$  that is much greater than the expected interstellar column ( $n_H \ll 10^{19} \text{ cm}^2$ ). (See Table 1). This conclusion is based on 2 of the 3 SSS spectra and on the BBXRT spectrum, all of which show this effect. There is no evidence for such anomalously high absorption in the SSS spectrum nor in the PSPC spectrum that were both obtained at phase  $\Phi = 0.06$ , i.e., near primary minimum when the K star is in front of the B star. Richards (1993) has discussed optical spectroscopy of Algol which show evidence for the existence of extensive intrastellar and circumstellar plasma in this system. The 'extra' absorption seen in some of the X-ray spectra of Algol may be another manifestation of this phenomenon.

Table 1. Best-Fit Parameters from X-Ray Modeling of  $\beta$  Per

Date (Year.Day)	Orbital Phase	$\chi^2_r$	$n_H$ ( $10^{20} \text{ cm}^{-2}$ )	$kT$ (keV)	$\log EM$ ( $\text{cm}^{-2}$ )
1979.041	0.89	1.13	4.9(+4.1, -3.4)	1.96(+0.26, -0.20) 0.75(+0.06, +0.05)	53.18(+0.05, -0.05) 52.83(+0.14, -0.11)
1979.042	0.06	1.59	0.0(+2.4, -0.0)	1.90(+0.22, -0.18) 0.58(+0.08, -0.14)	53.33(+0.04, -0.05) 52.71(+0.15, -0.23)
1979.221	0.67	1.13	8.3(+1.2, -1.2)	2.58(+0.18, -0.16) 0.64(+0.02, -0.02)	53.54(+0.02, -0.02) 53.11(+0.04, -0.04)
1990.342	0.20	1.20	5.8(+2.1, -1.9)	2.39(+0.16, -0.15) 0.68(+0.02, -0.02)	53.37(+0.03, -0.03) 52.94(+0.06, -0.06)
1992.030	0.06	0.84	0.2(+0.7, -0.2)	2.6(+5.9, -1.0) 0.67(+0.06, -0.09) 0.14(+0.03, -0.04)	53.21(+0.11, -0.08) 53.10(+0.09, -0.19) 52.61(+0.38, -0.16)

Note: The 1979 spectra were obtained with the SSS and have 86 degrees of freedom, the 1990 spectrum was obtained with BBXRT (260 d.o.f.), and the 1992 spectrum was obtained with the PSPC (11 d.o.f.) The errors quoted for all spectra represent the 90% confidence limits.

After properly taking into account the absorption, all 3 SSS spectra as well as the BBXRT spectrum of Algol are well-fit by a 2-component coronal plasma model in which one (the dominant) component has a temperature of  $\sim 2 - 3$  keV, and the other component is at  $\sim 0.7$  keV, as found by White *et al.* (1980). However, the PSPC spectrum of Algol is not well fit by such a 2-component model, but requires either a thermal plus power-law component model or a 3-component thermal plasma (3T) model, in which 2 of the components are the

same as those identified from the SSS and BBXRT spectra, and the third component is very soft ( $T \sim 0.15$  keV). Since the former class of models provide significantly poorer fits to the high-resolution spectra, we prefer the 3T model, although it clearly overconstrains the data, given the number of truly independent channels in a PSPC spectrum. The softest component has a much smaller emission measure ( $\sim 25\%$ ) than either of the others and would not be detectable in either the SSS or the BBXRT spectra due to their harder energy responses.

The PSPC spectra of the 3 other Algol systems also require the presence of a very soft component: in TW Dra and RZ Cas, its temperature is similar to that found in Algol itself ( $\sim 0.15$  keV), while in U Cep the best-fit temperature of this component is very cool,  $\sim 0.07$  keV. The PSPC spectrum of TW Dra requires only 2 thermal components (at 0.17 and 0.8 keV) for a good fit, while the spectra of U Cep and RZ Cas require an additional high-temperature component ( $T \sim 3 - 4$  keV) similar to that previously inferred for Algol.

The plasma parameters inferred from the PSPC spectra of these Algol systems are fairly similar to those inferred from the analysis of All-Sky Survey PSPC spectra of RS CVn systems by Dempsey *et al.* (1993): they found that most RS CVn spectra were well-fit by 2-thermal components, with typical temperatures of 0.17 and 1.4 keV, and with the high-temperature component having the dominant emission measure ( $EM_{low}/EM_{high} \sim 25\%$ ). The Algols analyzed here appear to have somewhat softer spectra than the RS CVn stars analyzed by Dempsey *et al.*, due to the greater contribution of the low-T component to the total emission measure, but this needs to be confirmed using a larger sample of Algols with PSPC spectra. [Any interpretation of the Algol PSPC spectra faces the complication that it is now known that the PSPC response matrix is poorly determined for the softest energy channels (*cf.* Napiwotzki *et al.* 1993), and thus the inferred parameters of the soft plasma component are actually more uncertain than the formal fit errors would indicate]. If further analysis confirms this difference between Algols and other types of active stars, it would be tempting to associate this unusually strong, soft component with a manifestation of the mass transfer phenomena characteristic of these semi-detached binary systems, such as high-temperature accretion regions. However, there are difficulties with this hypothesis, as Wade *et al.* 1993 have recently discussed, based on their PSPC spectra of 4 other Algol systems. Further theorizing should probably be deferred until a more complete sample of Algol PSPC spectra has been studied and an improved PSPC response matrix is available. In the meantime, the recent *EUVE* observation of Algol that has been made might help clarify this issue, assuming that the total absorption column during the observation was not so high as to absorb out most of the EUV photons!

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AN EFFICIENT WAY OF IDENTIFYING NEW ACTIVE STARS:  
A VLA SURVEY OF X-RAY-SELECTED ACTIVE STELLAR  
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**ABSTRACT** Source confusion makes it difficult to identify active stars, such as the RS CVn binaries, with X-ray sources detected in low angular resolution surveys. The radio/X-ray correlation discovered by Drake et al. (1989, 1992) provides an efficient way of confirming many active stars. Short (15 minute) VLA radio continuum observations of candidates having appropriate spectral types and X-ray to visual flux ratios obtained from an X-ray selected sample, combined with other information, has enabled us either to confirm or rule out proposed late-type star counterparts for 27 out of 32 X-ray sources selected from the *Einstein* Slew Survey.

We have been working to verify the proposed identifications of late-type stars with X-ray sources serendipitously discovered from X-ray surveys such as the *Einstein* IPC Slew Survey [hereafter ESS] that have large positional uncertainties of order of  $1' - 3'$ . Such identifications have a significant probability of being spurious. To confirm these identifications, we have searched for non-thermal radio sources spatially associated ( $\leq 1'' - 2''$ ) with a subset of the proposed stellar counterparts that have (if the associations are indeed correct) the high X-ray to optical luminosity ratios characteristic of active stars having coronae with large emission measures, such as RS CVn binary systems.

While not all late-type active stars are also detected as nonthermal radio sources, the detection of nonthermal radio emission from a star within the coarse X-ray error box confirms that the star is indeed an active star and the X-ray source without ambiguity. This use of radio data to confirm X-ray identifications is based on the work of Drake et al. (1989, 1992) who, *inter alia*, studied the correlation between the radio and X-ray properties of a large sample of RS CVn

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stars and showed that the X-ray and radio luminosities are correlated, with a nearly linear power-law dependence (cf. Güdel and Benz 1993),

$$\log S_6(\text{mJy}) = 1.181 \log(f_x/f_V) + 11.516 + \log f_V. \quad (1)$$

Here  $S_6$  is the observed 6-cm flux density,  $f_V = 3.38 \times 10^{-6} 10^{-V/2.5}$  is the visual V-band flux, and  $f_x$  is the observed X-ray flux, both in  $\text{ergs s}^{-1} \text{cm}^{-2}$ . This relation is based on 59 radio detected RS CVn stars and 31 upper limits. The standard deviation in the sample compared to this predicted ( $S_6/f_V$ ) is 0.70, i.e., most points lie within a factor of 5 of this mean line. This equation can be used to predict roughly the radio emission of an RS CVn system of known visual and X-ray flux. The scatter is real and indicative of the intrinsic variability of the X-ray and radio emission from RS CVn binaries. We therefore expect that some *bona fide* active stars will not be detected in radio observations if caught at epochs when their coronae are in quiescent states.

Some single GK giants and subgiants such as  $\epsilon$  Cap (G7 III) and 24 UMa (G4 III-IV) have  $\log L_x$  as high as 30.0 and  $f_x/f_V$  as high as -3.5, properties that overlap with the RS CVn stars. Such X-ray bright single stars can usually be discriminated from the active RS CVn systems using the  $S_6/f_x$  ratio, since the single stars are generally radio-weak. An RS CVn star with an X-ray flux  $f_x = 10^{-10} \text{ ergs s}^{-1} \text{cm}^{-2}$ , should have a large radio flux density of  $S_6 = 10 \text{ mJy}$  if  $V = 4.0$  according to equation (1). X-ray bright single stars (with some exceptions noted below) typically are not gyrosynchrotron radio sources, and hence the radio emission can be calculated assuming it is thermal (free-free) emission from the X-ray emitting plasma where

$$S_6 = 2 \times 10^9 f_x \quad (2)$$

(Drake and Linsky 1986). Thus, a single star with  $f_x = 10^{-10} \text{ ergs s}^{-1} \text{cm}^{-2}$ , would have  $S_6 = 0.20 \text{ mJy}$ , almost 2 orders of magnitude weaker than the hypothetical RS CVn. A radio observation can provide the crucial discriminant between X-ray bright single stars and RS CVn stars by selecting an observed X-ray flux limit that is high enough that equation (1) predicts a detectable radio flux density if the star is an RS CVn binary, but equation (2) predicts an undetectable radio flux for a single star,

Other types of active stars that satisfy the selection criteria and could possibly be misidentified as RS CVn stars include W UMa stars, FK Comae giant stars, and moderate-mass pre-main sequence (PMS) stars. W UMa stars appear to be radio-weak compared to RS CVn stars and thus the radio criterion will probably filter these out. PMS stars and FK Com stars have near-identical radio and X-ray properties to RS CVn stars, and optical criteria (e.g. strong lithium line and location for PMS stars, and lack of radial velocity variations for FK Com stars) are needed to distinguish them from RS CVn stars. PMS stars lie mainly in known star forming regions (e.g. Taurus and Ophiuchus dark clouds, Orion OB1, etc.) and thus are not expected to be a major serendipitous class except in certain regions of the sky. FK Com stars are fairly rare giant stars: only 20 FK Com stars are known, compared to about 200 RS CVn stars, thus  $\leq 10\%$  of the stars in our sample might be of this type.

We used a machine-readable version of the ESS (Elvis et al. 1992) as the input X-ray database and cross correlated this against the HD and SAO Catalogs, using a search radius of  $2.5'$ , which lies within the ESS 90% and 95%

confidence radii of  $1.2'$  and  $3.0'$ , respectively. In order to select the most active stars, we required that: (a) the optical star have a spectral type of F, G, or early K, (b) the inferred X-ray luminosity  $\log L_x$  exceed 29.5, (c) the ratio of X-ray to visual flux exceed  $-3.8$ , and (d) the observed X-ray flux  $f_x$  exceed  $10^{-12}$  ergs  $\text{s}^{-1}$   $\text{cm}^{-2}$ . These criteria will filter out most “normal” stars: the Sun, for example, fails criterion (b) by 2.5 dex and (c) by 2 dex.

There are 30 ESS stars satisfying our selection criteria for which we have obtained radio data with the VLA or the ATCA, and two more stars for which radio data are available in the literature. Typical detection thresholds for each observation of about 15 minutes duration are 0.25 mJy. Of these 32 stars, 12 were detected as radio sources with flux densities of between 0.35 and 7.8 mJy. In five other cases, despite the lack of a radio detection, there is other evidence in support of the identification of the stars with the X-ray sources. This implies that we can identify with confidence over half (17 out of 32 stars) of this sample of X-ray sources with the optical star candidates lying within their error circles. In five of the remaining cases, the observed radio flux density is less than that predicted by equation (1) by more than a factor of 5, suggesting that they are unlikely to be RS CVn stars. In another five cases for which the stars were not detected as radio sources there are other radio or optical sources in the X-ray error circles that are, we believe, the more likely counterparts. Thus, there are 10 cases for which the proposed identification of an HD star with an ESS source is probably erroneous, leaving only five stars of the original sample of 32 with uncertain status. None were detected as radio sources, but the upper limits are not definitive, and we find no plausible alternate identifications. Follow-up radio observations of these stars may detect some as new radio sources, given the known variability of RS CVn radio emission.

Thus, short radio observations (in some cases together with other information) have allowed us to confirm the identifications of 53% of a sample of possible X-ray bright active stars taken from the *Einstein* Slew Survey. We also find that a significant fraction (31%) of these are likely erroneous identifications, confirming the need for careful follow-up work on any counterparts proposed for X-ray sources detected in such surveys. The success of X-ray selection as a criterion for finding new radio-emitting stars supports the growing body of evidence that for several types of active stars nonthermal radio emission and thermal radio emission are tightly correlated. The reason for this correlation is not well understood and further studies are needed to understand the physical processes responsible for the correlation and perhaps also for coronal heating.

JLL acknowledges support from NASA grant NAG5-2075 to the University of Colorado.

## REFERENCES

- Drake, S. A. and Linsky, J. L. 1986, *AJ*, **91**, 602
- Drake, S. A., Simon, T., and Linsky, J. L. 1989, *ApJS*, **71**, 905
- Drake, S. A., Simon, T., and Linsky, J. L. 1992, *ApJS*, **82**, 311
- Elvis, M., Plummer, D., Schachter, J., and Fabbiano, G. 1992, *ApJS*, **80**, 257
- Güdel, M. and Benz, A. O. 1993, *ApJ*, **405**, L63

UNIVERSITIES SPACE RESEARCH ASSOCIATION  
GODDARD VISITING SCIENTIST PROGRAM

QUARTERLY TECHNICAL REPORT  
1993 Oct 01 – 1993 Dec 31

Employee Name: Ian M George

Activity: 5030-01A-39

Programatic Activities

Caldb Infrastructure & Access

Work has continued on the maintenance & development of the *OGIP Calibration Database*, an on-line database designed to contain calibration files for all instruments for which the OGIP is responsible for supplying scientific data. Calibration datasets & documentation continue to be delivered (albeit slowly) by the various instrument teams and GOFs of current mission, as well as by HEASARC personnel responsible for the restoration/conversion of data from old mission.

As of 1993 Dec 31, there were 974 data files (359 Mbyte) and 259 document files (40 Mbyte) within the database. The distribution between the various missions, along with the increase over the last 6 months, is shown in Figure 1.

The entire database is on-line on the `legacy.gsfc.nasa.gov` computer, and available world-wide via anonymous ftp, WWW etc. The number of files taken from the database is somewhat erratic, but continues to show an upward trend (Figure 2). A total of 2101 files were copied by (non-LHEA) ftp users in this quarter demonstrating its value to the general community. Interestingly, more calibration documents were taken than data files, dominated by recently produced *ROSAT* calibration documents (Figure 3a - most noticeably the spike in Oct/Nov). Until the official opening of *ASCA* calibration database on 1993 Dec 20, most calibration datasets for this instrument were undergoing testing and kept elsewhere. This explains the very small number of *ASCA* datasets copied from the 'official' archive this quarter (Figure 3b). This is expected to change now that the GO phase is fully underway.

FTOOLS/CALTOOLS s/w

Work has continued to develop calibration software tasks under the FTOOLS umbrella. Within the most recent FTOOLS distribution (v2.7), I contributed the following tasks:

- `ftools/caltools/rsp2rmf` - Converts SF format response matrices to OGIP FITS format.
- `ftools/caltools/marfrmf` - Multiplies an RMF matrix by an ARF dataset.
- `ftools/caltools/stw2pha` - Converts PHA o/p from IRAF/stwfits to OGIP format.
- `ftools/heasarc/sf2pha` - Converts SF format PHA files to OGIP FITS format.

and supervised OGIP programmers in the writing of several more.

I have also contributed the following tasks, which are currently undergoing  $\beta$ -testing prior to public release:

- **mathpha** - Performs mathematical operation on PHA datasets
- **froscon** - Multi-task wrapper to ease the conversion between IRAF and OGIP FTOOLS.

### Personal Research Activities

As usual, due to the demands of my programmatic work, I was able to dedicate little time to research this quarter.

In collaboration with Nandra (IoA, Cambridge, UK), a paper was finally finished on which we have been working for 4 years (!). In it we employ Monte Carlo techniques to calculate predicted X-ray spectra from a single, and from an ensemble of clouds surrounding an Active Galactic Nucleus (AGN). The results are briefly discussed in relation to historic *Ginga* observations of such objects, and have been accepted for publication.

Papers Published/Accepted (in quarter ending 1993 Dec 31)

#### *Refereed Journals:*

1. X-ray Observations of the Warm Absorber in NGC 3783  
Turner, T.J., Nandra, K., George, I.M., Fabian, A.C. & Pounds, K.  
1993. *Ap. J.*, 419, 127.
2. X-ray reprocessing by cold clouds in Active Galactic Nuclei  
Nandra, K & George, I.M.  
1994. *Mon. Not. R. astr. Soc.*, in press.

*Non-Refereed Journals, Conference Proceedings etc:*  
None

#### *Other Articles:*

1. Specification of Physical Units within OGIP FITS files  
George, I.M. & Angelini, L.  
1994. *Legacy*, 4, in press.  
(OGIP/93-001)
2. The Organization of the OGIP Calibration Database  
George, I.M. & Zellar, R.S.  
1994. *Legacy*, 4, in press.  
(CAL/GEN/93-006)

DATA FILES in CALDB 1994 jan 04  
(excl PCFs)

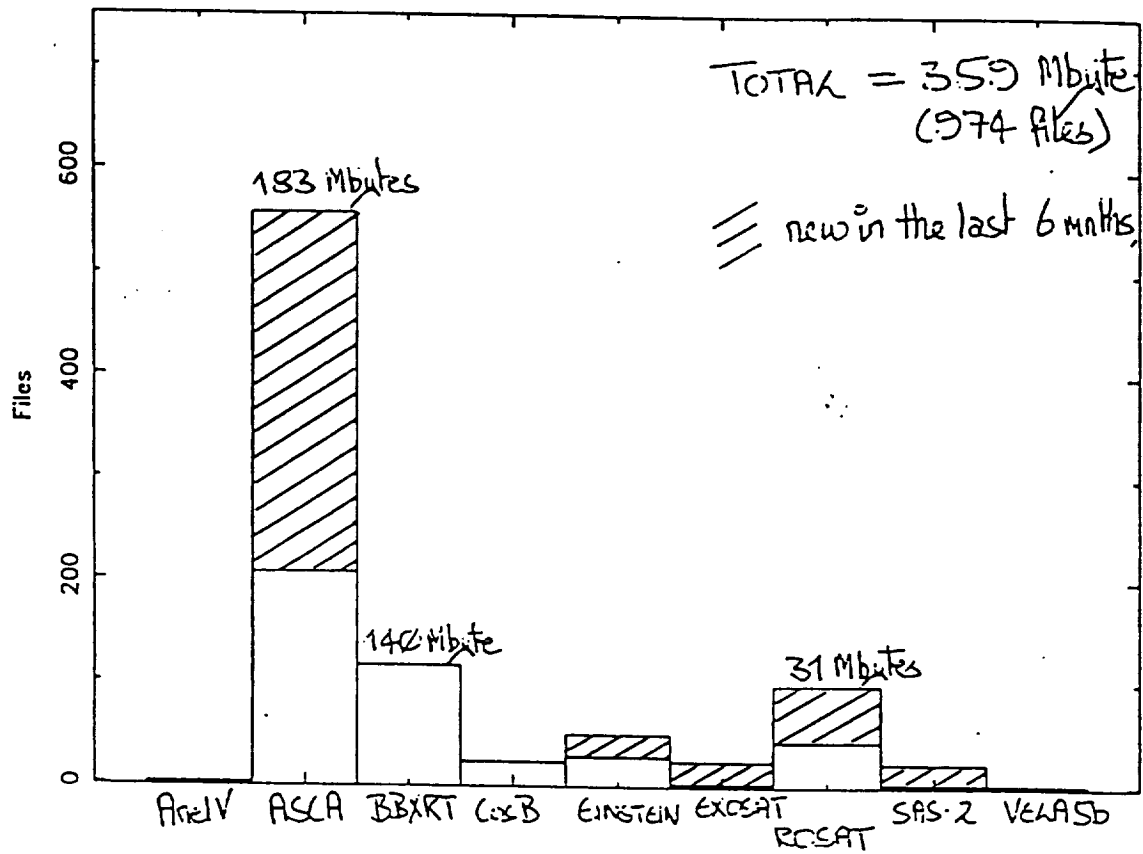
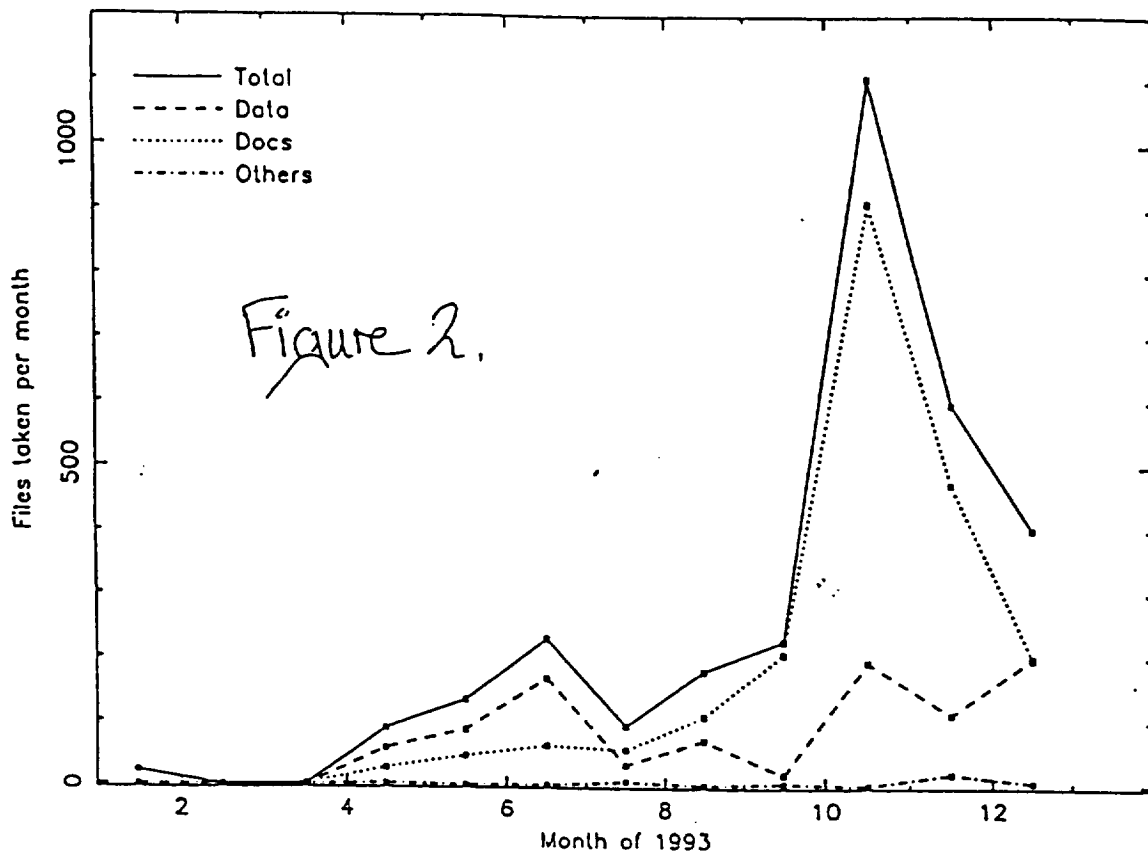


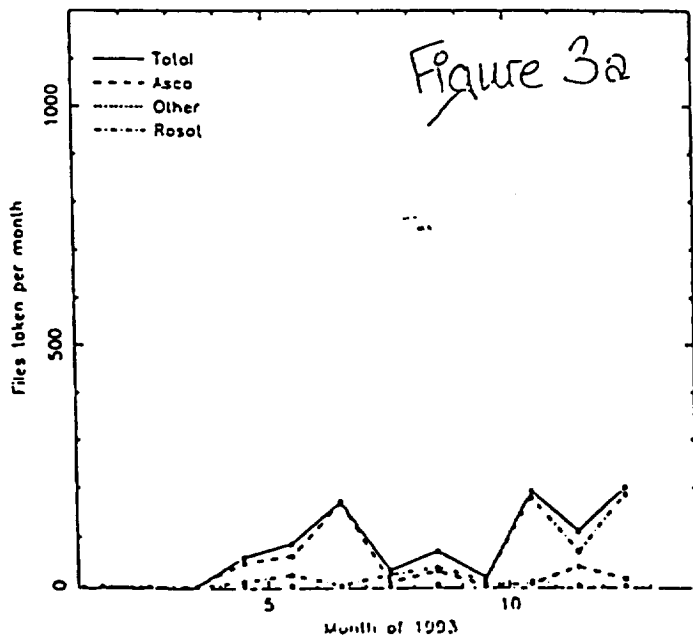
Figure 1.

CALDB FILES TAKEN (via anon ftp, excluding LHEA users)

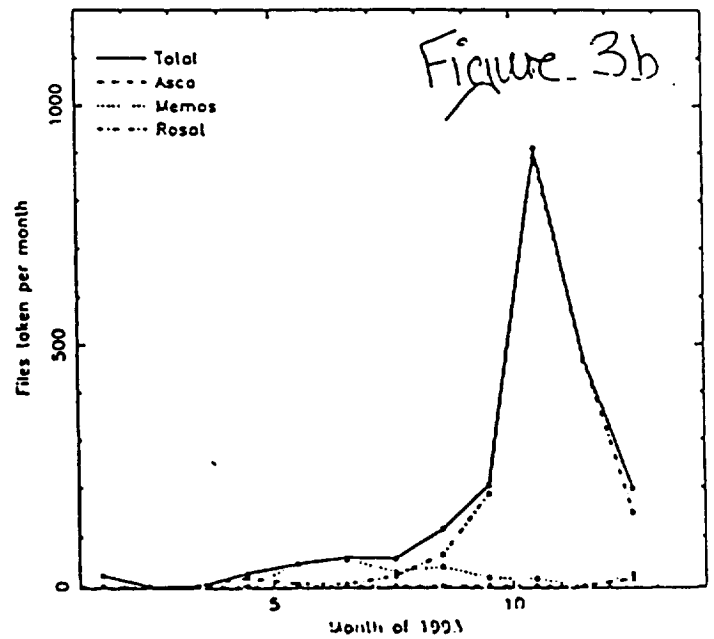


GEORGE 3-JA

CALDB DATA FILES TAKEN BY MISSION (via anon ftp)



CALDB DOCS FILES TAKEN BY MISSION (via anon ftp)



3. GRPPHA User's Guide

Yusaf, R. & George, I.M.  
1994. *Legacy*, 4, in press.  
(CAL/SW/93-010)

4. The Role & Initial Recommendations of the OGIP FITS Working Group

George, I.M. on behalf of the OFWG  
1994. *Legacy*, 4, in press.  
(OFWG.93.001)

Papers Submitted, not yet accepted by Refereed Journals:

1. Multi-wavelength Monitoring of the BL Lac Object PKS2155-304.

IV. Multi-Wavelength Analysis

Edelson, R., Krolik, J., Madejski, G. Maraschi, L., Pike, G., Urry, C.M., Brinkmann, W., Courvoisier, T.J.L., Ellithorpe, J., Horne, K., Aller, H.D., Aller, M.F., Ashley, M., Begelman, M., Blecha, A., Bouchet, P., Bratschi, P., Bregman, J.N., Carini, M., Celotti, A., Donahue, M., Fiegelson, E., Filippenko, A.V., Fink, H., George, I.M., Glass, I., Heidt, J., Hewitt, J., Hughes, P., Kollgaard, R., Kondo, Y., Koratkar, A., Leighly, K., Marscher, A., Matheson, T., Martin, P.G., Miller, H.R., Noble, J.C., O'Brian, P., Pian, E., Reichert, G., Saken, J.M., Shull, J.M., Sitko, M., Smith, P., Sun W.-H., Tagliaferri, G., Treves, A., Wagner, S., Wamsteker, W. & Warwick, R.S.  
1993. *Astrophys. J.*, submitted.

2. The UK Deep and Medium Surveys with ROSAT: Log N – Log S

Branduardi-Raymont, G., Mason, K.O., Warwick, R.S., Carrera, F.J., Mittaz, P.D., Puchnarewicz, E.M., Smith, P.J., Barber, C.R., Pounds, K.A., Stewart, G.C., McHardy, I.M., Jones, L.R., Merrifield, M.R., Fabian, A.C., McMahon, R. Ward, M.J., George, I.M., Jones, M.H., Lawrence, A. & Rowan-Robinson, M.  
1993. *Mon. Not. R. astr. Soc.*, submitted.

Non-Local Travel

Cambridge (UK) & Munich (Germany) 1993 Oct 26 – 1993 Nov 06

The purpose of the trip was twofold. The primary purpose to attend an international workshop on the scientific results, data analysis techniques, and calibration issues held at MPE (Munich, Germany) over the period Nov 01 – 05. A number of the ROSAT Guest Observer Facility (GOF) staff at NASA/GSFC, and myself (as a representative of the HEASARC calibration database), have been working closely with the PSPC instrument team at MPE to improve the in-flight calibration of the instrument. Recently it has become apparent that the detector is exhibiting an unexpected time-dependency in its spectral calibration. The goal of the meeting was therefore to discuss the problem, and determine the best approach to updating the calibration & informing users on short, medium and long timescales.

En route to Germany, a stopover was made in the UK in order to collaborate with Prof. Fabian & Dr Nandra at the Institute of Astronomy (Cambridge, UK) on a number of scientific issues, as well as the (inter-related) spectral calibration problems of the PSPC.

Work Planned for the period 1994 Jan 01 – 1994 Mar 31

Projected activities for the next quarter include:

- continued development of OGIP calibration infrastructure & access software.
- writing of *ROSAT* AO-5 and *ASCA* AO-2 observing proposals

Progress Report 1 October - 31 December 1993

Task # 5030 - 01A-39  
Laura A. Whitlock, Ph. D.



**Programmatic**

Provided user support for the on-line Vela 5B and HEAO 1 data bases. Worked to create the Ariel 5 FITS light curves. The files are now ready and I am only waiting for enough disk space to become available to create the data base index, etc. which will allow the files to be BROWSED via the anonymous accounts on NDADSA and Legacy.

With Brendan Perry (HSTX), completed the ingest of the HEAO 1 A-2 MAX data base into NSSDC. Work will begin in the first quarter of 1994 to convert these data to FITS and put them on-line.

Also with Brendan Perry, I acquired the SAS-3 data base and software from Dr. Jonathan Woo at MIT. These data are now awaiting ingest into the HEASARC jukebox. They will be put into the queue of data sets to be converted to FITS format, but will probably not get any attention until 1995 or later.

Completed transferring data from OSO 8, HEAO 1, and Ariel 5 from 9 track to 4mm tapes. Am now working on making the 8mm duplicates to complete this initial phase of the 'data recovery' project. The duplication effort should be complete in early February 1994. It is of note that the 8 mm versions of the HEAO 1 A-2 PHA and MAX data bases I created are being used by Mike Stark (U. Maryland) and Dr. Jean Swank (NASA/GSFC) in their research.

Interfaced with Dr. Ed Kemper (HSTX) regarding his work with the OSO-8 data from the Frost experiment. We are coordinating his effort with the HEASARC expertise in FITS formats to insure that we will not have to remake the files he generates when the data eventually are ingested into the HEASARC. Also, we are sharing the knowledge we uncover about the OSO-8 mission and experiments as we work on our respective OSO data sets. I have, and will one day reformat, data from the Serleimitsos gamma-ray spectrometer experiment.

Organized a committee and began to develop a "standard" for putting all-sky, scanning satellite data into FITS format, organizing it in such a way as to be accessible by the user community in an efficient manner. There is much interest (as expressed by the EUVE archive, the COBE archive, and various scientists with future missions) in the HEASARC leading the development of such a system. I have been put in charge of this effort by virtue of the fact I know most about scanning data. Alas, once again in the wrong place at the wrong time.

Completed writing the Vela 5B Calibration/User's Guide. It is now in the hands of Dr. Ian George (USRA) for his final inputs and editing. The finished product has been promised for the February 1994 HEASARC User's Group meeting.

Wrote 2 articles for the next issue of *Legacy*, due out in February 1994:  
"Once Upon a Time in the Basement" by L. Whitlock and "ASM Data Bases Update" by L. Whitlock and P. Tyler(HSTX).

## Science

I did about as much science this quarter as last quarter, namely, almost none at all. But there were a few tidbits.....

With Dr. Eric Gotthelf (USRA), I began to develop an approach to how we were going to do the automated search of the Vela 5B archive to look for X-ray transients. This work must get going full-steam in early 1994, in order to be completed in the appropriate ADP timeframe.

In late December, I finally got back to working on the "Vela 5B Observations of the Small Magellanic Cloud" paper that Jim Lochner and I have been working on for over a year. We had expected to submit this paper in early 1993, but some problems arose with our analysis technique which required some additional work. It has now been sent out for a final internal review (January 1994) and should be submitted to the *Ap. J.* in the first quarter of 1994.

Paper entitled "Quasi-Periodic Oscillations of VV Puppis" by J.N. Imamura, J. Middleditch, J.D. Scargle, T.Y. Steiman-Cameron, L.A. Whitlock, M.T. Wolff, and K.S. Wood, was published in December 20, 1993 *Ap. J.* , 419, 793.

1993 4th Quarter Report  
M. F. Corcoran (660-038)

1.

To: Denise Dunn  
From: Dr. M. F. Corcoran  
Task No: 660-038  
Subj: 4th Quarter Technical report, 1Oct 1993 - 31 Dec 1993  
Date: 31 Jan 1993

PROGRAMMATIC TASKS:

1) ROSAT Public archive:

a) Supervision of data ingest into the archive is continuing. In the 4th quarter US data ingested into NDADS was complete through December 1993, and ingest of MPE data was complete through Oct 1993.

b) The first volume of ROSAT CDs were created during the 4th quarter. Volume 1 consists of 6 months worth of public ROSAT broad-band images for both HRI and PSPC in both FITS and GIF formats, and compressed exposure maps, if available.

c) I gave presentations on the status of the ROSAT archive to the 5th HEASARC User's Group Meeting and at the ROSAT User's group meeting in the 4th quarter.

d) During the 4th quarter I've received and answered questions about the archive from the following people:

1 PHAST::SZKODY	1-OCT-1993	mpe archive
2 NDADS::CORCORAN	1-OCT-1993	RE: mpe archive
3 PHAST::SZKODY	1-OCT-1993	RE: mpe archive
4 NDADS::CORCORAN	1-OCT-1993	RE: mpe archive
5 PHAST::SZKODY	1-OCT-1993	RE: mpe archive
6 SMTP%"corcoran@barne	4-OCT-1993	uk700283
7 SMTP%"corcoran@barne	4-OCT-1993	urgent request for MPE Jun data
8 SMTP%"corcoran@barne	4-OCT-1993	wg600186p
9 SMTP%"corcoran@barne	4-OCT-1993	wg600062h status from Frank
10 HEASRC::SMTP%"chu@si	4-OCT-1993	SN1987A
11 SMTP%"spellegr@eso.o	5-OCT-1993	background map
12 SMTP%"corcoran@barne	5-OCT-1993	Re: wg600062h status from Frank
13 NDADS::CORCORAN	5-OCT-1993	RE: background map
14 STSCIC::SAMBRUNA	5-OCT-1993	
15 NDADS::CORCORAN	5-OCT-1993	re: 700488
16 STSCIC::SAMBRUNA	5-OCT-1993	RE: re: 700488
17 SMTP%"corcoran@barne	5-OCT-1993	wg700488p
18 CFA::"ov@cfa257"	6-OCT-1993	RE: re: Cas A and Tycho HRI Images
19 SMTP%"corcoran@barne	6-OCT-1993	Cas A (150086) and Tycho (150045) data
20 NDADS::CORCORAN	6-OCT-1993	wg600186p
21 SMTP%"corcoran@barne	7-OCT-1993	Re: Cas A (150086) and Tycho (150045) d
22 RSDPS::DAMON	7-OCT-1993	RE: wg600186p
23 RSDPS::DAMON	7-OCT-1993	RE: wg600186p
24 HEAGIP::KSMALÉ	7-OCT-1993	mpe archive contents
25 SMTP%"corcoran@barne	7-OCT-1993	wg600186p
26 HEAGIP::KSMALÉ	7-OCT-1993	mpe data
27 NDADS::CORCORAN	7-OCT-1993	RE: mpe data
28 NDADS::CORCORAN	7-OCT-1993	RE: re: 700488
29 LHEAVX::PETRE	8-OCT-1993	bitch, bitch...

1993 4th Quarter Report  
M. F. Corcoran (660-038)

2.

30	HEAGIP::WHITE	8-OCT-1993	?
31	HEAGIP::WHITE	8-OCT-1993	rosat archive
32	NDADS::CORCORAN	8-OCT-1993	RE: rosat archive
33	HEAGIP::WHITE	8-OCT-1993	RE: rosat archive
34	SMTP%"corcoran@barne	8-OCT-1993	ROSAT archive
35	HEAGIP::WHITE	10-OCT-1993	ndads images
36	HEAGIP::WHITE	10-OCT-1993	another example
37	HEASRC::SMTP%"brm@cf	12-OCT-1993	Rosat Archive
38	SMTP%"corcoran@barne	12-OCT-1993	rosat archive
39	RSDPS::DAMON	18-OCT-1993	data ready
40	SMTP%"corcoran@barne	20-OCT-1993	Re: archive
41	HEASRC::SMTP%"greive	20-OCT-1993	looking for German data
42	RSDPS::DAMON	20-OCT-1993	Jun/Jul data
43	SMTP%"corcoran@barne	21-OCT-1993	Re: HRI calibration archival data of A22
44	HEASRC::SMTP%"HERTZ@	22-OCT-1993	ROSAT Archive Question
45	NDADS::CORCORAN	23-OCT-1993	re: ROSAT Archive Question
46	NDADS::CORCORAN	25-OCT-1993	status of cal00244h
47	SMTP%"HERTZ@XIP.NRL.	25-OCT-1993	BROWSE
48	NDADS::CORCORAN	25-OCT-1993	RE: BROWSE
49	SMTP%"HERTZ@XIP.NRL.	25-OCT-1993	RE: BROWSE
50	RSDPS::DAMON	28-OCT-1993	RP500156
51	HEASRC::SMTP%"chu@si	1-NOV-1993	thank you & updates on bubbles
52	RSDPS::DAMON	1-NOV-1993	Requested dataset RH100244
53	RSDPS::DAMON	2-NOV-1993	Re: Requested dataset RH100244
54	RSDPS::DAMON	3-NOV-1993	FWD: RE: RH100244
55	HEASRC::SMTP%"rlp@ro	10-NOV-1993	archive question
56	LHEAVX::SMTP%"jrm@ge	11-NOV-1993	FSTAGE-Successful (fwd) really?
57	NDADS::CORCORAN	12-NOV-1993	wp600099 and wp500062
58	SMTP%"corcoran@barne	12-NOV-1993	looks like the disk is back up
59	SMTP%"corcoran@barne	12-NOV-1993	re: archive question
60	7189::ogelman	12-NOV-1993	Re: wp600099 and wp500062
61	NDADS::CORCORAN	12-NOV-1993	Re: wp600099 and wp500062
62	NDADS::CORCORAN	12-NOV-1993	Re: wp600099 and wp500062
63	44156::FWALTER	12-NOV-1993	where are the German archival data?
64	NDADS::CORCORAN	12-NOV-1993	re: where are the German archival data?
65	7189::ogelman	12-NOV-1993	Re: wp600099 and wp500062
66	44156::FWALTER	12-NOV-1993	RE: re: where are the German archival da
67	HEASRC::SMTP%"ejgaid	13-NOV-1993	MPE archive data
68	HEASRC::SMTP%"chu@si	14-NOV-1993	archive
69	NDADS::CORCORAN	15-NOV-1993	RE: archive
70	SMTP%"corcoran@barne	15-NOV-1993	wh800068
71	LHEAVX::TURNER	16-NOV-1993	archive
72	NDADS::CORCORAN	16-NOV-1993	RE: archive
73	HEAGIP::TYLER	17-NOV-1993	User question about ROSAT data file
74	NDADS::CORCORAN	17-NOV-1993	re: 200430
75	HEAGIP::TYLER	19-NOV-1993	Another User Question
76	NCF::CCHEUNG	19-NOV-1993	Any insight?
77	NDADS::CORCORAN	19-NOV-1993	re: rp200515
78	HEASRC::SMTP%"greive	22-NOV-1993	German data
79	HEASRC::SMTP%"MSIARK	22-NOV-1993	
80	20009::WNB	23-NOV-1993	
81	HEASRC::SMTP%"greive	30-NOV-1993	Another look for wp500041
82	HEAGIP::TYLER	2-DEC-1993	User Question
83	HEAGIP::TYLER	2-DEC-1993	Another Q I'm not sure how to answer...
84	SMTP%"ejgaidos@space	2-DEC-1993	wh800068

**1993 4th Quarter Report**  
**M. F. Corcoran (660-038)**

3.

85	HEAGIP::KSMAL	2-DEC-1993	rp500034
86	HEAGIP::TYLER	4-DEC-1993	User Q
87	HEASRC::SMTP%"KOWALS	6-DEC-1993	archive
88	NDADS::CORCORAN	6-DEC-1993	RE: German data
89	NDADS::CORCORAN	6-DEC-1993	rp200515/GL494
90	HEASRC::SMTP%"wrf@cf	6-DEC-1993	ROSAT public archive
91	NDADS::CORCORAN	7-DEC-1993	RE: ROSAT public archive
92	NDADS::CORCORAN	7-DEC-1993	problems downloading from the anonymous
93	NDADS::BIMSON	7-DEC-1993	RE: problems downloading from the anonym
94	NDADS::CORCORAN	7-DEC-1993	RE: archive
95	NDADS::CORCORAN	7-DEC-1993	some remaining problems with protection
96	NDADS::BIMSON	7-DEC-1993	RE: some remaining problems with protect
97	NDADS::CORCORAN	7-DEC-1993	RE: ROSAT public archive
98	NDADS::CORCORAN	7-DEC-1993	RE: archive
99	NDADS::CORCORAN	7-DEC-1993	RE: rp500034
100	NDADS::CORCORAN	7-DEC-1993	using rosat archival data
101	NDADS::CORCORAN	7-DEC-1993	re: rp500041
102	NDADS::CORCORAN	7-DEC-1993	re: rp700315
103	NDADS::CORCORAN	7-DEC-1993	ROSID vs ROSPUBLIC
104	HEAGIP::TYLER	7-DEC-1993	RE: re: rp700315
105	NDADS::CORCORAN	7-DEC-1993	re: rp800322.evr
106	SMTP%"greivel@astroa	7-DEC-1993	re: rp500041
107	SMTP%"Postmaster@nda	10-DEC-1993	Undeliverable Mail
108	HEASRC::SMTP%"mledlo	10-DEC-1993	another question
109	NDADS::CORCORAN	10-DEC-1993	RE: another question
110	STSCIC::SAMBRUNA	15-DEC-1993	.evr files for archival data
111	NDADS::CORCORAN	15-DEC-1993	RE: .evr files for archival data
112	HEASRC::SMTP%"hennes	21-DEC-1993	Rosat images
113	SMTP%"corcoran@barne	22-DEC-1993	re: 600110 (Rosat images)
114	NCF::CCHEUNG	22-DEC-1993	ROR 141809
115	NDADS::CORCORAN	22-DEC-1993	RE: ROR 141809
116	NDADS::CORCORAN	22-DEC-1993	RE: ROR 141809
117	HEASRC::SMTP%"wrf@cf	23-DEC-1993	
118	NDADS::CORCORAN	23-DEC-1993	wh800068
119	SMTP%"wrf@cfa208.har	23-DEC-1993	Happy Holidays (Emperor Akihito's birthd
120	EAST::"mauche@imager	28-DEC-1993	ndads session

e) Network transfer of the data from the NDADS jukebox to the HEASARC jukebox proved unreliable. In the 4th quarter we instituted a transfer of data on tape from NDADS to the HEASARC.

## 2) Rationalized FITS development

a) In November I went to Munich to discuss RDF development with MPE and to present the RDF formats at the MPE ROSAT workshop. An important topic on which we reached consensus was the format for the file which will contain the raw detector coordinates for each detected photon. It was decided that this information would be provided in a separate file and should be implemented into RFITS by the end of the 4th quarter.

b) In the 4th quarter RFITS version 1.7 was released which was fully PROS-compatible. Changes/adjustments were being made through the end of the 4th quarter. In particular, a module to create the file containing the raw coordinates was added at the end of the 4th quarter. In addition, the routine to write the data to tape for distribution was created and tested.

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c) The draft of the data products guide appendix describing the RDF formats was updated to include comments received from CFA and GSFC.

d) Trend data file development continued in the 4th quarter.

e) During the 4th quarter I've answered the following e-mail regarding rationalized FITS testing:

1 EAST::"frh@cfa235.ha	1-OCT-1993	Re: qual and qlim files
2 RSDPS::RSDC_RFITS	1-OCT-1993	#143_CFA::frh@cfa235 Re: qual and qlim
3 SMTP%"corcoran@barne	4-OCT-1993	document origin of EXPTIME keyword
4 LHEAVX::PETRE	4-OCT-1993	holy cow!
5 SMTP%"corcoran@barne	4-OCT-1993	re: #80_MPE - HRI event rates
6 RSDPS::RSDC_RFITS	4-OCT-1993	#144 SMTP%corcoran@barnegat.gsfc.nasa.go
7 RSDPS::RSDC_RFITS	5-OCT-1993	#145_CFA::janet@cfa254 QLM enhancement
8 RSDPS::RSDC_RFITS	8-OCT-1993	#146_RSSW New RFITS Release
9 RSDPS::RSDC_RFITS	12-OCT-1993	#147_SEUFERT New FITS file.
10 RSDPS::RSDC_RFITS	12-OCT-1993	#148_MPE::MPECr1::ACH_OP MPE::RSDC_RFIT
11 RSDPS::RSDC_RFITS	12-OCT-1993	#149_SEUFERT status of RFITS.
12 RSDPS::RSDC_RFITS	12-OCT-1993	#150_SEUFERT RE: Problem with RFITS V1
13 RSDPS::RSDC_RFITS	13-OCT-1993	#151_MPE::MPECr1::GRU MPE::RSDC_RFITS:4
14 RSDPS::RSDC_RFITS	13-OCT-1993	#152_SEUFERT RE: MPE-CONV500 (source li
15 RSDPS::RSDC_RFITS	13-OCT-1993	#153 SMTP%rosat@linde.harvard.edu RDF/n
16 RSDPS::RSDC_RFITS	13-OCT-1993	#154 SMTP%corcoran@barnegat.gsfc.nasa.go
17 RSDPS::RSDC_RFITS	13-OCT-1993	#155_CFA::belinda@cfa222 times in heade
18 RSDPS::RSDC_RFITS	15-OCT-1993	#156 SMTP%corcoran@barnegat.gsfc.nasa.go
19 ROSGIP::TURNER	18-OCT-1993	for yuour info
20 ROSGIP::TURNER	18-OCT-1993	archive
21 RSDPS::RSDC_RFITS	21-OCT-1993	#157_CFA::janet@cfa254 pspc allqlm exte
22 RSDPS::RSDC_RFITS	22-OCT-1993	#158 SMTP%janet@cfa254.harvard.edu QLIM
23 RSDPS::RSDC_SASS	29-OCT-1993	#1019_SEUFERT STRGEV.OBI file.
24 RSDPS::SWEETLAND	29-OCT-1993	RE: You're not alone
25 RSDPS::RSDC_SASS	29-OCT-1993	#1564_MPE::MPECr1::GRU MPE::RSDC_SASS:1
26 RSDPS::SWEETLAND	5-NOV-1993	PSPC/HRI STD/ALL QLMS
27 HEASRC::SMTP%"mo@cfa	10-NOV-1993	MPE FITS format
28 RSDPS::RSDC_RFITS	10-NOV-1993	#169_RSSW HRI Print file extension & ir
29 HEAGIP::GEORGE	11-NOV-1993	RDF samples
30 HEAGIP::GEORGE	12-NOV-1993	FYI - A good idea ? (we should discuss t
31 HEASRC::SMTP%"mo@cfa	12-NOV-1993	MPE FITS format
32 NDADS::CORCORAN	12-NOV-1993	RE: MPE FITS format
33 RSDPS::RSDC_RFITS	12-NOV-1993	#170_CFA::janet@cfa254 PRT file comment
34 SMTP%"corcoran@barne	17-NOV-1993	proposed format for split target event f
35 RSDPS::RSDC_RFITS	17-NOV-1993	#171_NDADS::CORCORAN proposed format fo
36 RSDPS::RSDC_RFITS	17-NOV-1993	#172_SEUFERT RFITS teleconf.
37 RSDPS::RSDC_RFITS	18-NOV-1993	#173 SMTP%frh@cfa235.harvard.edu Re: #1
38 RSDPS::RSDC_RFITS	18-NOV-1993	#174_SWEETLAND RE: #172_SEUFERT RFITS
39 RSDPS::RSDC_RFITS	18-NOV-1993	#175_SWEETLAND RE: #173 SMTP%frh@cfa235
40 RSDPS::RSDC_RFITS	18-NOV-1993	#176_HEASRC::NDADS::CORCORAN RE: #172_S
41 RSDPS::RSDC_RFITS	18-NOV-1993	#177_SWEETLAND RE: #176_HEASRC::NDADS::
42 RSDPS::RSDC_RFITS	18-NOV-1993	#178_RSSW ALLQLM.ANP file for PSPC.
43 RSDPS::RSDC_RFITS	18-NOV-1993	#179_CFA::janet@cfa254 HRI QLM assignme
44 RSDPS::RSDC_RFITS	18-NOV-1993	#180_CFA::mo@cfa234 New extensions
45 RSDPS::SEUFERT	18-NOV-1993	guide star and delay time message from M
46 SMTP%"corcoran@barne	18-NOV-1993	

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47 RSDPS::RSDC_RFITS	18-NOV-1993	#181_NDADS::CORCORAN guide star informa
48 RSDPS::RSDC_RFITS	18-NOV-1993	#182_NDADS::CORCORAN ASPECT time delay
49 NDADS::CORCORAN	18-NOV-1993	SIMBAD correlation file
50 RSDPS::RSDC_RFITS	18-NOV-1993	#183_CFA::mo@cfa234 Re: ASPECT time de
51 RSDPS::SEUFERT	19-NOV-1993	RE: SIMBAD correlation file
52 RSDPS::RSDC_RFITS	19-NOV-1993	#184_SWEETLAND RSVV - New directories f
53 RSDPS::RSDC_RFITS	19-NOV-1993	#185_SUMANT Order of RDF files on ROSAT
54 RSDPS::RSDC_RFITS	19-NOV-1993	#186_SUMANT Order of RDF files on ROSAT
55 RSDPS::RSDC_RFITS	19-NOV-1993	#187_SEUFERT RFITS status summary.
56 RSDPS::RSDC_RFITS	19-NOV-1993	#188_CFA::mo@cfa234 Re: #185_SUMANT O
57 RSDPS::RSDC_RFITS	23-NOV-1993	#189_SWEETLAND Rfits version 1.6
58 RSDPS::RSDC_RFITS	24-NOV-1993	#190_SEUFERT Problem list for RFITS rel
59 RSDPS::RSDC_RFITS	24-NOV-1993	#191_SEUFERT RFITS release 1.6.
60 RSDPS::RSDC_RFITS	25-NOV-1993	#192_MPE::MPECR1::ACH_OP MPE::RSDC_RFIT
61 RSDPS::RSDC_RFITS	29-NOV-1993	#193_CFA::mo@cfa234 RFITS 1.6 comments
62 RSDPS::RSDC_RFITS	29-NOV-1993	#194 SMTP%@secyt.gov.ar:visitor9@fcaglp.
63 EAST::"frh@cfa235.ha	29-NOV-1993	FYI: for inclusion in Revised DPG
64 EAST::"frh@cfa235.ha	29-NOV-1993	Re: Naming conventions.
65 RSDPS::RSDC_RFITS	30-NOV-1993	#195_SEUFERT Summary of telecon with SA
66 RSDPS::RSDC_RFITS	1-DEC-1993	#196 SMTP%janet@cfa254.harvard.edu Blac
67 RSDPS::RSDC_RFITS	3-DEC-1993	#198_MPE::MPECR1::GRU MPE::RSDC_RFITS:5
68 RSDPS::RSDC_RFITS	3-DEC-1993	#199_MPE::MPECR1::ACH_OP MPE::RSDC_RFIT
69 RSDPS::RSDC_RFITS	3-DEC-1993	#200_SWEETLAND New HRI ANC EPHEM extens
70 RSDPS::RSDC_RFITS	3-DEC-1993	#201_CFA::mo@cfa234 RFITS1.7 and PROS
71 RSDPS::RSDC_RFITS	3-DEC-1993	#202_CFA::janet@cfa254 Test EPHEM file
72 RSDPS::RSDC_RFITS	3-DEC-1993	#203_SEUFERT Answers to Achim's questio
73 RSDPS::RSDC_RFITS	6-DEC-1993	#204_SWEETLAND New, improved HRI ANC EP
74 RSDPS::RSDC_RFITS	6-DEC-1993	#205_SEUFERT Files to add to RFITS.PAR
75 RSDPS::RSDC_RFITS	6-DEC-1993	#206_NDADS::CORCORAN
76 RSDPS::RSDC_RFITS	6-DEC-1993	#207_SWEETLAND Telecon Tuesday Dec. 7 a
77 RSDPS::RSDC_RFITS	6-DEC-1993	#208_SEUFERT RE: Telecon Tuesday Dec. 7
78 RSDPS::RSDC_RFITS	6-DEC-1993	#209_CFA::mo@cfa234 Re: TELECON
79 RSDPS::RSDC_RFITS	7-DEC-1993	#210_CFA::mo@cfa234 Re: RFITS Telecon
80 HEASRC::TURNER	7-DEC-1993	rdf for dpg text
81 RSDPS::RSDC_RFITS	7-DEC-1993	#211 SMTP%janet@cfa254.harvard.edu Late
82 HEAGIP::ANGELINI	8-DEC-1993	
83 RSDPS::RSDC_RFITS	8-DEC-1993	#212_SEUFERT Summary of telecon with SA
84 RSDPS::RSDC_RFITS	8-DEC-1993	#213_SWEETLAND New PSPC RFITS RAW file
85 NDADS::CORCORAN	10-DEC-1993	
86 HEAGIP::ANGELINI	10-DEC-1993	
87 RSDPS::RSDC_RFITS	10-DEC-1993	#215_SEUFERT RE: lpd@cfa271 Re: #1045_
88 RSDPS::RSDC_RFITS	13-DEC-1993	#217_SWEETLAND RFITS release 1.8
89 RSDPS::RSDC_RFITS	13-DEC-1993	#218 SMTP%janet@cfa254.harvard.edu Re:
90 RSDPS::RSDC_RFITS	13-DEC-1993	#219_SWEETLAND RE: #218 SMTP%janet@cfa2
91 MPECR1::WHV	15-DEC-1993	
92 RSDPS::RSDC_RFITS	16-DEC-1993	#220 SMTP%corcoran@barnegat todays tele
93 NDADS::CORCORAN	16-DEC-1993	description of RDF files
94 SAVAX::BCS1	16-DEC-1993	RE: description of RDF files
95 NDADS::CORCORAN	16-DEC-1993	RE: description of RDF files
96 RSDPS::RSDC_RFITS	16-DEC-1993	#221 SMTP%corcoran@barnegat HDUCLAS key
97 RSDPS::RSDC_RFITS	16-DEC-1993	#222_SWEETLAND RE: #221 SMTP%corcoran@b
98 RSDPS::RSDC_RFITS	16-DEC-1993	#223_SWEETLAND RE: #221 SMTP%corcoran@b
99 RSDPS::RSDC_RFITS	16-DEC-1993	#114_HEASRC::NDADS::CORCORAN RE: #223_S
100 RSDPS::RSDC_RFITS	16-DEC-1993	#115_CFA::mo@cfa234 RDF 1.8 comments
101 RSDPS::RSDC_RFITS	17-DEC-1993	#116_CFA::frh@cfa235 Off-axis angle mis

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102	SAVAX::BCS1	20-DEC-1993	RE: description of RDF files
103	RSDPS::RSDC_RFITS	20-DEC-1993	#224_NDADS::CORCORAN OFFAX_AN info
104	RSDPS::RSDC_RFITS	21-DEC-1993	#225_SWEETLAND RFITS release 1.9
105	RSDPS::RSDC_RFITS	21-DEC-1993	#226_SEUFERT Status of RFITS.
106	MPECR1::WHV	23-DEC-1993	RE: description of RDF files
107	RSDPS::RSDC_RFITS	23-DEC-1993	#227_SUMANT AR Lac RDF tapes mailed to

### 3) OGIP FITS

As part of the effort to develop multi-mission FITS formats, the OGIP has instituted a panel to help standardize formats/keywords/data structures. I am a member of this panel.

a) this panel continued it's bi-weekly meeting in the 4th quarter. In particular we discussed development of a set of file keywords used to classify FITS files and extensions, and discussed other relevant FITS issues.

b) I've received/responded to the following e-mail during the 4th quarter:

1	HEAGIP::GEORGE	1-OCT-1993	channel
2	SMTP%"fitsbits-reque	8-OCT-1993	AUTHOR keyword
3	HEASRC::GEORGE	13-OCT-1993	Subtle change of HDUCLASn scheme for mat
4	HEASRC::GEORGE	13-OCT-1993	Beep beep Oooops - This is the REAL plan
5	SMTP%"fitsbits-reque	15-OCT-1993	Re: World Coordinate Systems
6	HEAGIP::GEORGE	18-OCT-1993	HDUCLAS proposal
7	SMTP%"fitsbits-reque	25-OCT-1993	AUTHOR --> CREATOR keyword
8	SMTP%"fitsbits-reque	25-OCT-1993	Re: AUTHOR --> CREATOR keyword
9	SMTP%"fitsbits-reque	25-OCT-1993	AUTHOR --> CREATOR keyword
10	SMTP%"fitsbits-reque	25-OCT-1993	Re: AUTHOR --> CREATOR keyword
11	SMTP%"fitsbits-reque	26-OCT-1993	ORIGIN and CREATOR keywords
12	SMTP%"fitsbits-reque	26-OCT-1993	Re: AUTHOR --> CREATOR keyword
13	SMTP%"fitsbits-reque	26-OCT-1993	Re: AUTHOR --> CREATOR keyword
14	SMTP%"fitsbits-reque	26-OCT-1993	Re: ORIGIN and CREATOR keywords
15	SMTP%"fitsbits-reque	26-OCT-1993	Digitized Sky Survey CD-ROMs
16	SMTP%"fitsbits-reque	26-OCT-1993	Re: AUTHOR --> CREATOR keyword
17	SMTP%"fitsbits-reque	26-OCT-1993	Re: AUTHOR --> CREATOR keyword
18	SMTP%"fitsbits-reque	26-OCT-1993	Re: AUTHOR --> CREATOR keyword
19	SMTP%"phjj@ruchem.ru	26-OCT-1993	Re: AUTHOR --> CREATOR keyword
20	SMTP%"fitsbits-reque	29-OCT-1993	FITSIO: ASCII tables definition
21	SMTP%"fitsbits-reque	29-OCT-1993	Rewriting NAXIS2
22	SMTP%"fitsbits-reque	29-OCT-1993	Re: FITSIO: ASCII tables definition
23	SMTP%"fitsbits-reque	29-OCT-1993	Re: ORIGIN and CREATOR keywords
24	SMTP%"fitsbits-reque	29-OCT-1993	Re: 8-character limit
25	NDADS::CORCORAN	3-NOV-1993	HDUCLAS proposal
26	SMTP%"fitsbits-reque	3-NOV-1993	CTYPE for pixel image
27	SMTP%"fitsbits-reque	3-NOV-1993	Re: CTYPE for pixel image
28	SMTP%"fitsbits-reque	4-NOV-1993	Re: ORIGIN and CREATOR keywords
29	SMTP%"fitsbits-reque	4-NOV-1993	Re: CTYPE for pixel image
30	SMTP%"fitsbits-reque	4-NOV-1993	
31	SMTP%"fitsbits-reque	4-NOV-1993	Example HDUCLASn values
32	SMTP%"fitsbits-reque	4-NOV-1993	HDUCLASn keywords (again)
33	SMTP%"fitsbits-reque	4-NOV-1993	re: rewriting NAXIS2
34	HEAGIP::GEORGE	9-NOV-1993	HDUCLASn values required (radial PSFs)
35	NDADS::CORCORAN	12-NOV-1993	RE: HDUCLASn values required (radial PSF

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36	HEAGIP::GEORGE	12-NOV-1993	RE: HDUCLASn values required (radial PSF
37	SMTP%"fitsbits-reque	15-NOV-1993	New FITS Support Office Telephone Number
38	LHEAVX::SMTP%"pence@	17-NOV-1993	FITS votes,
39	NDADS::CORCORAN	17-NOV-1993	RE: FITS votes,
40	SMTP%"fitsbits-reque	27-NOV-1993	FITS table version numbers.
41	SMTP%"fitsbits-reque	30-NOV-1993	Plans for a FAQ
42	LHEAVX::SMTP%"pence@	30-NOV-1993	sample COS-B FITS file
43	LHEAVX::SMTP%"pence@	30-NOV-1993	Sample SAS-2 FITS file
44	SMTP%"fitsbits-reque	1-DEC-1993	Re: FITS table version numbers.
45	SMTP%"fitsbits-reque	2-DEC-1993	Re: FITS table version numbers.
46	SMTP%"fitsbits-reque	2-DEC-1993	Re: FITS table version numbers.
47	SMTP%"fitsbits-reque	2-DEC-1993	Re: FITS table version numbers.
48	SMTP%"fitsbits-reque	3-DEC-1993	Re: FITS table version numbers.
49	SMTP%"fitsbits-reque	8-DEC-1993	Re: BZERO/BSCALE question
50	SMTP%"fits@nssdca.gs	16-DEC-1993	FITS basics and information (periodic po
51	SMTP%"fits@nssdca.gs	16-DEC-1993	FITS basics and information (periodic po

## USER SUPPORT ACTIVITIES

a) I provided no GOF support in the 4th quarter.

b) I gave demos of IDL tools for ROSAT data analysis at the USRA/GSFC ROSAT workshop in November

c) I received the following e-mail about GOF activities:

1	LHEAVX::TURNER	1-OCT-1993	
2	LHEAVX::TURNER	1-OCT-1993	
3	NDADS::CORCORAN	1-OCT-1993	
4	LHEAVX::WHITE	2-OCT-1993	rosat cds
5	HEAGIP::GEORGE	3-OCT-1993	ROSAT PSPC Detector Maps have moved !!!!
6	LHEAVX::TURNER	3-OCT-1993	meeting reminder
7	ROSGIP::TURNER	12-OCT-1993	
8	LHEAVX::TURNER	13-OCT-1993	
9	HEASRC::KSMAL	13-OCT-1993	rosat users handbook
10	HEASRC::KSMAL	15-OCT-1993	Tina Bird's survey
11	HEASRC::KSMAL	15-OCT-1993	Tina Bird
12	HEAGIP::KSMAL	15-OCT-1993	I'm going away
13	ROSGIP::TURNER	25-OCT-1993	meeting reminder
14	NDADS::CORCORAN	25-OCT-1993	a favor...
15	ROSAT::REQUEST	26-OCT-1993	Rosat status 68
16	EAST::"frh@cfa235.ha	28-OCT-1993	Re: meeting at airport
17	EAST::"frh@cfa235.ha	28-OCT-1993	Re: meeting at airport
18	ROSAT::REQUEST	29-OCT-1993	CalGuide figures Update
19	HEAGIP::KSMAL	1-NOV-1993	Crystal Martin, GO
20	HEAGIP::KSMAL	1-NOV-1993	More GO info
21	HEAGIP::KSMAL	2-NOV-1993	ROSAT Symposium Demos
22	LHEAVX::KSMAL	3-NOV-1993	ROSAT Symposium Demos (again)
23	HEAGIP::KSMAL	3-NOV-1993	ROSAT Symposium Demos (again)
24	HEAGIP::KSMAL	3-NOV-1993	argh.
25	HEAGIP::KSMAL	4-NOV-1993	idl testing
26	LHEAVX::SMTP%"petre@	5-NOV-1993	symposium demos

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27	LHEAVX::TURNER	5-NOV-1993	Important Calibration Guide Information
28	LHEAVX::KSMALÉ	5-NOV-1993	parking permit
29	NDADS::CORCORAN	9-NOV-1993	missing idl libraries
30	LHEAVX::SMTP%"rbj@ro	9-NOV-1993	Re: missing idl libraries
31	EAST::"modell@athena	15-NOV-1993	rosat newsletter article on German/UK da
32	NDADS::CORCORAN	15-NOV-1993	newsletter article
33	LHEAVX::TURNER	16-NOV-1993	rosat meeting
34	HEASRC::TURNER	18-NOV-1993	Notes from the meeting
35	HEASRC::KSMALÉ	19-NOV-1993	E-mail and phone stats
36	HEASRC::TURNER	22-NOV-1993	dpg
37	LHEAVX::GEORGE	22-NOV-1993	All ROSAT PSPC Detector Maps now availab
38	HEAVAX::TURNER	30-NOV-1993	Meeting Reminder
39	HEAGIP::GEORGE	1-DEC-1993	PSPCEXP (v1.0.3) available in developme
40	ROSGIP::GEORGE	1-DEC-1993	LaTeX & Unix
41	HEASRC::KSMALÉ	7-DEC-1993	casa .ps files
42	NDADS::CORCORAN	7-DEC-1993	e-mail stats
43	LHEAVX::DUESTERHAUS	20-DEC-1993	Release of AO5 is almost here - so you k
44	HEASRC::KSMALÉ	21-DEC-1993	AAS booth schedules...
45	LHEAVX::DUESTERHAUS	30-DEC-1993	ao5

#### SCIENCE ACTIVITIES

1) I presented an invited talk on the ROSAT observations of the Carina Nebula at "The Eta Carina Region: A Laboratory for Stellar Astrophysics" workshop in La Plata, Argentina in the 4th quarter. I also presented talks on my work on the X-ray spectra of hot stars and on the ROSAT public archive at the Observatory of La Plata.

2) I presented the results of the ROSAT observation of the Carina Nebula at the USRA/GSFC ROSAT workshop.

3) "Effects of Coronal and Shock-Produced X-rays on the Ionization Distribution in Hot Stars", MacFarlane, et al. on which I am a co-author was published in the 4th quarter (ApJ 419, 813).

#### PLANNED ACTIVITIES, 1st QUARTER 1994

1) Continue supervision of ROSAT Public Archive including ingest of WG data.

2) Finish development of rationalized FITS calibration data files.

3) Continue guest observer support activities

4) Publish results of analysis of ROSAT observations of Carina Nebula, V444 Cyg and BBXRT data of Zeta Ori.

5) Write draft of paper summarizing work with Catelli on Sco OB1

6) Begin analysis of Cyg OB2 ROSAT PSPC observation.

## Quarterly Technical Report

Eric M. Schlegel

Activity: 5000-616

This report will cover the period of 1 October to 31 December 1993.

During the above named period, I have been working on a mixture of science and programmatic tasks. These will be outlined below.

### Science

The *ROSAT* data on the galaxy NGC 6946 has been submitted for publication and the referee's report received. It will require a few weeks to address the referee's comments due to the intervening AAS meeting. Some of the results will be discussed in a talk to be given by Knox Long (STScI) at the AAS meeting.

One of the resolved sources in NGC 6946 is an extraordinarily bright supernova remnant. An *ApJ Letters* paper has been submitted for publication and the referee's report received. I have already revised the paper to meet the referee's concerns, so the paper will be re-submitted before the AAS meeting.

None of the historical supernovae are visible in NGC 6946 and upper limits on the x-ray emission have been assigned. A brief paper is in preparation describing the upper limits. The upper limits paper has required some understanding of Bayesian probability theory. A small program has been written to generate upper limits based upon the total observed counts from the region of a potential source, the number of background counts, and the relative exposure times of the "source" region and the background. The best previous software available made an approximation to the proper relation. Tables using the new software will likely be published as a separate, brief paper.

Work is in progress to publish upper limits on the  $\gamma$ -ray emission from cataclysmic variables. A simple estimate indicates that CVs should be  $\gamma$ -ray emitters, largely due to Compton upscattering of ultraviolet photons off non-thermal radio electrons. The predicted fluxes lie above the sensitivity limits of the *Compton* EGRET instrument. No CVs have been detected, with the resulting upper limits at least a factor of 5 below the predicted fluxes. The data will be published and used to argue for a proposal to use the OSSE instrument (the lowest energy instrument) on *Compton*. In addition, the lack of  $\gamma$ -ray emission is being tackled from the point of view of understanding the ultraviolet emission.

A paper is nearing completion describing the results of work done during the

summer of 1993 with a student from the University of Maryland. We examined the amateurs' databases on the dwarf novae VW Hyi and Z Cha (both southern hemisphere objects). The databases extend over 40 years, representing more than 10,000 visual observations of these two stars. The data have been analyzed and are presently being digested.

### Programmatic Tasks

During the above period, very few programmatic tasks other than preparation for the ROSAT Science Symposium were done.

The ROSAT GOF had approximately a half-dozen guest observers during this period, of which I explicitly dealt with three, and substantially helped an additional GO.

Two memos have been written describing ROSAT data. The first memo expands upon an analysis started by G. Hasinger (MPE) and describes the long-term stability of the flux calibration of ROSAT's PSPC.

The ROSAT Science Symposium was held 8-10 November 1993 at the Adult Education Center of the University of Maryland. Approximately 130 people attended the 3 day meeting which was designed to highlight ROSAT science done by US observers. Previous ROSAT meetings have been devoted to data analysis issues or have been held in Germany. The proceedings of the symposium will be published by the American Institute of Physics Press. Of a maximum of 107 contributions, only 11 authors have stated that they will not publish their symposium contribution, leaving 96 possible contributions for the proceedings. To date, I have in hand 85 of those contributions. Each contribution has been read and graded. The grades are assigned on the basis of meeting the size requirements (automatic failure) and typos or grammatical constructions (the author is permitted to fix or not, as (s)he sees fit). Approximately 25% of the papers will need to be returned to the authors for correction. I am aiming to send the complete manuscript to the publisher perhaps as early as 1 February.

### Travel

Travel during the report period was completely local. I attended the October 1993 Maryland Astrophysics Conference. The subject was "The Evolution of X-ray Binaries". I presented a poster on the black hole candidate LMC X-1 using BBXRT data. The material in the poster will appear in the ApJ in February. I was a member of the Local Organizing Committee for the ROSAT Science Symposium.

### Tasks Planned

The following tasks are planned for the first quarter of 1994. I intend to work to complete the supernova X-ray review paper I am writing, likely destined for a

review journal such as *Physics Reports*. A portion of the paper will appear in the proceedings of the *ROSAT* science symposium, held in November. I also will submit proposals to the AO-2 *ASCA* cycle. I am also working on a paper describing the X-ray light curve of SN1978K in NGC 1313.

The only programmatic task on the agenda is the completion of the proceedings of the *ROSAT* Science Symposium.

The only travel planned in the coming quarter is to attend the American Astronomical Society meeting in January.

21 January 1994

This quarter, my first full quarter with USRA and the Laboratory for High Energy Astrophysics, has brought a great deal of satisfaction. It continues to be a pleasure to work with the other members of the *ROSAT* Guest Observer Facility on the various aspects of operating this observatory.

Both programmatic and science work have gone well. Goals for the GOF have been refined and progress is being made in fulfilling them. Software which I have written for use in the data reduction of *ROSAT* PSPC pointings where extended objects or the diffuse X-ray background is of interest is being converted to run both in IDL and FTOOLS. The exposure correction routine is now operable in both and is being used by the community. (I am presently working on an adaptation of this software for use in HRI observations.) I have finished the definitions required for the production of *ROSAT* trend data files (files which can be used to better monitor the daily operation of *ROSAT*). Unfortunately, little progress has been made on improving the spectral calibration of the PSPC as we are still waiting for additional ground calibration data to be collected by MPE (now scheduled for the middle of February). We have, however, improved our understanding of the residual systematics in the calibration.

I spent the last two weeks of October and the first week of November at MPE for both programmatic and scientific work. With participants from MPE, GSFC, CfA, and Leicester, we held extensive discussions of the calibration status of the PSPC and HRI and outlined procedures for improvements. There were also extensive discussions covering the much needed *ROSAT* Users Handbook and the responsibility for writing it.

In conjunction with my work with the GOF, I've had one paper on the calibration of the *ROSAT* PSPC ("An Updated Calibration of the *ROSAT* PSPC Particle Background" by Plucinsky, Snowden, Hasinger, Briel, and Pfeffermann, in *The Astrophysical Journal*, 418, 519) appear in press while a second ("Analysis of *ROSAT* XRT/PSPC Observations of Extended Objects and the Diffuse Background" by Snowden, McCammon, Burrows, and Mendenhall, in *The Astrophysical Journal*, to appear in March) was accepted for publication.

My science work in the last quarter has gone very well. During the time at MPE I completed the final processing of the cosmic diffuse background data from the *ROSAT* all-sky survey; essentially the culmination of the last five and a half years of my effort spent at MPE. The maps provide a data set of a quality significantly higher than any past survey and which will be unequaled by any planned future mission. Using these data, I have two papers which I have submitted to the *Astrophysical Journal*, one which is near submission, and about a dozen more in the planning stage. I also presented a paper based on these data, "A View of the Diffuse X-ray Sky," at the 1<sup>st</sup> Annual *ROSAT* Science Symposium and Data Analysis Workshop (College Park, MD, of which I was a scientific organizer) and gave a colloquium "X-ray observations of the LISM by *ROSAT*" at the GSFC Laboratory for Astronomy and Solar Physics. The *ROSAT* data provide a unique look at structures ranging from the local interstellar medium (my major area of interest) to nearby galaxies and more distant clusters of galaxies. I've continued my analysis of *ROSAT* pointed-observation data and am working on the response to the referee's comments on a paper about M101.



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Return-Path: <TURNER@heavax.gsfc.nasa.gov>

Date: Tue, 4 Jan 1994 17:29:29 -0500 (EST)

To: cwheat@renzo.usra.edu

Subject: Quarterly Technical Report-Jane Turner

Status: RO

USRA Quarterly Report for Oct1 -Dec 31 1993

T.Jane Turner

## Programmatic Work:

An unofficial first attempt was made to compile all available ROSAT PSPC information into a PSPC "Calibration Guide". This large document has been available on the legacy anonymous ftp account since Oct 1993.

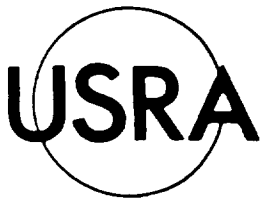
Trip to UK and Germany: Oct 26th-Nov 6th 1993

The primary reason for the trip was to attend the ROSAT calibration workshop at MPE in Germany. MPE held an international workshop November 3-4th, during which scientific results from ROSAT data were shown, and data analysis techniques discussed. November 2nd and 5th a more informal small group met to discuss the detailed calibration requirements for the ROSAT PSPC instrument. Recently some of the GSFC GOF staff (Turner, George and Snowden) have been working closely with the PSPC instrument team in Germany, to improve the energy calibration of the instrument. Analysis of in-flight calibration data by MPE and GSFC had shown a time dependency to the PSPC gain, which has not yet been properly parameterized. Work continues at GSFC and MPE in this area. We also discussed (with Dr Corcoran) the new ROSAT data file formats which will be released when the ROSAT data is reprocessed (to improve the quality of the processed data in the archive, and fix small errors which have been discovered over the mission lifetime). The reprocessing will start in December 1993, and so it was crucial to reach agreement on a number of outstanding issues, this was accomplished.

Other issues discussed included the choice of supplementary calibration targets for the end of the PSPC mission. The possibilities for a period of Targets of Opportunity (now ruled out due to late November pointing problems, which wasted several days of PSPC gas), and importantly, an unexplained problem with the accuracy of the X-ray positions in both PSPC and HRI data.

Following the trip to MPE I gave a summary talk on the PSPC energy calibration at the USRA "ROSAT SCIENCE SYMPOSIUM AND DATA ANALYSIS WORKSHOP" (November 8-10, 1993).

I worked on the HRI off-axis point spread function with the SAO ROSAT team. A tried and tested functional form has now been released to the community.



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University  
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Illinois, University of  
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Indiana University  
Iowa State University  
Johns Hopkins University  
Kansas, University of  
Lehigh University  
Louisiana State University  
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(College Park)  
Massachusetts Institute of  
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(Minneapolis)  
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(Stony Brook)  
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Ohio State University  
Old Dominion University  
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Medical Branch at Galveston  
Toronto, University of  
Utah State University  
Virginia Polytechnic Institute  
and State University  
Virginia, University of  
Washington, University of  
Washington University  
(St. Louis)  
William and Mary, College of  
Wisconsin, University of  
(Madison)  
Yale University

## Science:

Two papers have been published in Ap.J during this quarter:

Turner, T.J., Urry, C.M. and Mushotzky, R.F. 1993 ApJ 418, 653

Turner, T.J., Nandra, K., George, I.M., Fabian, A.C. and Pounds, K.A. 1993 ApJ 419, 127

En route to Germany we stopped in the UK for several days to work with colleagues at the Institute of Astronomy, Cambridge. We primarily worked with Dr Nandra and Prof. Fabian on a ROSAT observation of an interesting Active Galaxy, Mkn841. We have obtained numerous ROSAT PSPC observations of Mkn841, with simultaneous IUE and optical observations, over the mission lifetime. We are currently analysing those data, and attempting to interpret them in the light of current popular models for active galaxies, with discussion of the applicability of accretion disk models to the data.

Work in progress, continuing through the next quarter, includes:

Examination of sources likely to provide good calibration measurements (to trace the channel shift in the energy calibration) above 1.5 keV. Hard sources - PSR0540, Greiner TOO, Vela X, PKS2155, Mk421, Mrk 463, VW Hy, Cyg Loop.

Continued work on the ROSAT Users Handbook, in collaboration with MPE.

Interpretation of the Mkn841 optical/UV/X-ray monitoring data, as a follow up the Mkn841 GSFC-Cambridge collaboration described in the previous section.

## TECHNICAL REPORT FOR OCT. 1 TO DEC. 31, 1993

Ken Ebisawa (USRA Research Scientist )

task # 666-024

code 668, ASCA Guest Observer Facility

Office of Guest Investigator Program

Laboratory for High Energy Astrophysics, NASA/GSFC

### PROJECT WORK

- Participated in the ASCA software/science meeting in Sep. 27 to Oct. 2, ISAS, Japan, and subsequently worked on development of the ASCA data analysis system at ISAS.
- Developed and tested ASCA data analysis system with other ASCA GOF members and programmers at GSFC.
- Made ASCA GIS response data files for ASCA Guest Observers' use.
- Supported US ASCA Guest Observers' observation planning

### RESEARCH

- Participated "The Evolution of X-ray Binaries" meeting at Univ. of Maryland from Oct. 11 to Oct. 13, and gave a review talk with the title "Accretion Disk Spectra".
- Submitted a review article for the proceedings of the aforementioned meeting.
- Completed a work on GX339-4 energy spectra with Mr. Ueda (ISAS) and Dr. Done (Leicester University) (see below).
- Worked on the Ginga observation data of the bright X-ray nova GS1124-68, and submitted a paper to PASJ (see below).
- *Paper Accepted:*
  - Ueda, Y., Ebisawa, K. and Done, C., "Spectral Study of GX339-4 in the Low Intensity State Observed with GINGA" Publication of the Astronomical Society of Japan, Accepted in Oct., 1993.
- *Papers Submitted:*
  - Ebisawa, K. et al., "Spectral Evolution of a Bright X-ray Nova GS1124-68 Observed with GINGA", submitted to Publication of the Astronomical Society of Japan, Nov. 1993.

## Technical Report October 1–December 31 1993

Koji Mukai (Task number: 93-03-00)

**ASCA matters:** There were two milestones for ASCA during the 4th quarter of 1993: the beginning of the guest observer phase (Oct 15) and the deadline for first round papers (Nov 30). These milestones drove the requirement for a public release of FTOOLS/XSELECT software for mid November which will be compatible with FRFread version 3.

I embarked upon my third trip to Japan for 1993 during this quarter (19 Nov - Dec 3), to install the new version of the software, perform an end-to-end test of the analysis system and help our Japanese colleagues use them (additional documentation, answering questions etc.). The major part of the installation task was to drastically update the script which I created in an earlier trip to Japan, now called "naps" (New ASCA Processing Script). I manage to combine the testing of this new script with my research activities (see below). In addition, I consulted Dr. Takeshima of Riken on "mkfilter," which is created by Dr. Takeshima and is an essential part of processing, and discussed future plans for improvements.

In addition, I attended a one-day calibration meeting held at ISAS, which was primarily for the benefit of the Japanese ASCA team members and was conducted in Japanese. I was able to present the status of the Goddard software and find out the latest status of the instruments (hardware and calibration).

While I was at Goddard, I participated in GO support in two ways: one is to establish the procedure for detailed planning of AO-1 observations, the other is in the writing of "the ABC guide" (which explains how to analyze ASCA data), although both of these efforts were led by Dr. Charles Day. The first US guest observer observation did take place in late October and the first GO data were delivered by Christmas.

**Science:** At the beginning of the quarter, I attended the conference on "Evolution of X-ray Binaries" held at University of Maryland, and presented a talk on evolution of X-ray transients containing blackhole primaries.

However, most of the research activities this quarter concentrated on the ASCA PV phase observations. I have submitted a paper on FO Aqr, to be published as one of the first round papers out of the ASCA mission, with Drs. Ishida and Osborne. Dr. Ishida submitted a paper on EX Hya, with Dr. Osborne and myself as co-authors. I also started analysis of PV phase data on AM Her and YY Gem while I was testing the "naps" script — the best way to test the processing pipeline is to analyze the data with a scientist's point of view, which did reveal relatively minor problems with the script and its component programs. Both these datasets look very promising, although more analysis is clearly needed before reaching any conclusions.

**Next quarter:** The Washington AAS meeting and ASCA AO-2 proposal submission support will dominate January; the "New horizon of X-ray Astronomy" conference to be held in Tokyo and AO-2 proposal review will dominate March; hopefully, I may have time to do science in February!

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15707 Erwin Court  
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January 24, 1994

To: Crystal Wheatley, USRA.

Re: Quarterly technical report, 10/1/93 - 12/31/93.

XTE: Now that the Critical Design Review for the XTE Guest Observer Facility is over, the real work begins. During this quarter I was extremely busy performing further detailed development of the interfaces between various parts of the XTE effort; between the people working in this building and Building 28 where the Data Archiving and Distribution subsystem will be located, between the flight operations center in Building 3 (the SOF) and ourselves, etc. This is a question of software interfaces rather than just the physical connections between the buildings, and as different codes have widely differing software philosophies this effort is quite complex.

In addition, I have been leading the FTOOLS effort within the XTE project. As Build 2 of the software was due on November 30th, we had very little time between CDR and the end of the Build to design, code and test the prototype codes for the accumulation of spectra and light curves from the complex telemetry-style format FITS files created by the XTE FITS Formatter (see Rots' technical report for more details of this effort). I have just one programmer helping me with this FTOOLS effort. In addition, our work had to be coordinated with the larger FTOOLS project, which is largely funded by ASCA. This group is helping with the extension of some of the existing FTOOLS to deal with vector-style and array-style FITS formats, and this effort requires careful coordination.

During this quarter I chaired the search committee for the fourth XTE scientist, who will be taking the main role in the proposal management and calibration arenas. After interviewing three candidates, a decision was reached just before Christmas. In the meantime, I am performing the duties of this scientist in addition to my own. This means helping to design the Proposal Management interface between ourselves and the Mission Planning team, designing the calibration FITS files for all aspects of XTE calibration, from deadtime through effective area and field of view files to response

matrices and background subtraction. I have even made the first cut at creating the proposal forms for the XTE Announcement of Opportunity, so that these can be examined by the Science Working Group.

**ASCA:** My observation of the X1820-303 was performed at the beginning of October as part of the Performance Verification phase of the mission. I helped to select the experiment modes to be adopted during the observation, and performed some verification of the data obtained. Next quarter I will take a more active role in the analysis of the data, with a view to presenting preliminary results at the "New Horizon of X-ray Astronomy" meeting, to be held in Japan in 1994 March. X1820-303 is an X-ray binary in a globular cluster, with an extremely short 685-sec orbital period, indicating that in this case the mass-donating secondary is a degenerate dwarf rather than the more normal main sequence star.

In addition, I am involved in the analysis of the data from the observations of X1822-371 and X1916-053. The former object is an accretion disk corona source with a 5.57-hr orbital period, and I 'practiced' on these data while I was awaiting the delivery of the data from X1820-303. Several binary cycles of the source, including two eclipses, were observed, and I examined the light curves and performed a preliminary spectral analysis. Dr. Nick White is leading the analysis of this object.

**Conferences, travel:** I gave an invited talk at the University of Maryland, at the "Evolution of X-ray Binaries" meeting (Oct 11-13). My talk was entitled "Precession and Long-Term Cyclic Variability in X-ray Binaries." The first part of this quarter was spent in almost full-time preparation for this talk, and after the meeting I prepared the text to be published in the Conference Proceedings.

**Science:** My main effort this quarter was towards the invited talk described above, and in the preliminary examination of ASCA data. My managerial responsibilities soaked up most of the rest of my time, which is an undesirable state of affairs and one I hope I can find a way around in the future. The hiring of a fourth GOF scientist should relieve some of this strain from 1994 February onward.

During this quarter my paper "Cygnus X-3 in an "ultrahigh" X-ray state with no detected  $K\alpha$  emission" appeared in the *Astrophysical Journal*.

My main programmatic effort for the next quarter will be the design and coding of the FTOOLS software deliveries for Build 3, and the coordination of effort within the XTE GOF as a whole to ensure that milestones are met. In particular I will be getting into further details of the archiving and data distribution issues, and the policies for releasing data to the community. I will be in charge of the GOF part of the Build 2 software demonstration to the XTE Project Managers and will help coordinate a design review for the Code 631 effort. I would also like to spend more time at the "sharp end of the stick" in the programming effort, to ensure that I keep up to date in my knowledge of what the issues are that the programmers face. I would also like to spend some time investigating Perl and Khoros as possible development and release tools. Scientifically, I will be analyzing the data from the ASCA observation of X1820-303 in preparation for the Japan meeting, and helping with the data analysis and

interpretation of the observations of X1822-371 and X1916-053.

Please contact me if further  
details are required,

Alan

Dr. Alan P. Smale

Universities Space Research Association  
Goddard Visiting Scientist Program  
Technical Report  
4<sup>th</sup> Quarter 1993

Arnold H. Rots  
Task number: 5030-04A-39

22 February 1994

Programmatic work during this quarter was dominated by the Build 2 software delivery which was scheduled for December 1, 1993.

## 1 XTE-SOC

In addition to the items detailed below, a large number of varied, smaller issues connected with the GOF, the SOC in general, and the XTE mission as a whole, required my attention

### 1.1 XFF

The Build 2 version of XFF was finished around mid-December, but could not be fully tested due to lack of operational Instrument Team (IT) software. The Build 2 version contains all the basic functionality required of the final product, though the FITS database is still limited to PCA and HEXTE data. The design is such, though, that inclusion of other subsystems mainly requires changes in a single include file.

### 3 Research

The work for the Build 2 delivery, considering our very limited manpower resources, was such that only minimal progress could be made on the analysis of ROSAT data and the temporal analysis tools.

I did submit a proposal for an ADS grant with CoIs Barrett, Schlegel, and Smale.

### 4 Travel

I attended the third annual meeting on Astronomical Data Analysis Software and Systems, in Victoria, BC, from 12-15 October, 1993. I presented a poster paper on the XTE FITS database. A separate travel report has been filed on this conference visit.

### 5 Next Quarter

During the next quarter I intend to make XFF work with a variety of data modes, to thoroughly update the documentation, and to finish a large part of the XFF version for Build 3. In particular, we hope to get everything working that is useful for the XTE end-to-end test in March. I shall compile data descriptor dictionaries and develop template FITS files. I will continue the design of the FITS Data Extractor which will act as a Data Base Management System for the hierarchy of XFF-generated FITS files.

I will further pursue application of the Gregory-Loredo timing analysis algorithm and I intend to work on our NGC 1961 ROSAT observations.

USRA REPORT 10/1/93 - 12/31/93  
Dr A.B.Giles  
Employee Task No: 93-05-00

During the above period Dr Giles continued as the Software Manager for the PCA experiment software development and deliveries to the XTE Science Operations Center. He also continued to support the Goddard team developing the PCA detectors for the XTE satellite.

**Meetings:-**

Dr Giles regularly attended the following list of meetings at GSFC in connection with the PCA experiment:

PCA software deliveries to SOC (Chair)	alt. Tuesdays	
PCA representative on the SOC meetings	most Mondays	
PCA full team group meeting	every Friday	
PCA representative on GOF meetings	occasional	
XTE Science Working Group (SWG)	14-15 October	GSFC
1st Instrument Operations Working Group (IOWG) - PCA representative	15 October	GSFC
2nd IOWG	3 November	GSFC
Instrument Teams (IT)	4 November	GSFC
SOC Science Monitoring subsystem review	16 December	STX
SOC Health & Safety subsystem review	22 December	STX

At the SWG meeting Dr Giles made two presentations, one on the design requirements for the SOF real time monitoring system and one on PI Data Access.

**Conferences:-**

Dr Giles attended the conference entitled "The Evolution of X-Ray Binaries" at the University of Maryland at College Park from 11-13 October.

**Travel:-** None

**Activities:-**

As PCA Software Manager Dr Giles major activity of the period was the preparations and deliveries for the SOC Build 2. All the required documentation was delivered on time and in good shape at the end of October. Much of the required software was delivered on time at the end of November with some last minute additions being made in the first week of December. A few items were not delivered and these have been deferred to Build 3. These items were generally for the GOF rather than the SOF. Staff departures and unexpected extended leave created difficulties for both the PCA and SOC software effort during Build 2.

In December work commenced on the Build 3 cycle and the Project continues to pursue a very aggressive schedule to meet the August 31st 1995 launch date. The Project are placing increasing work loads on Dr

Giles in terms of paperwork and documentation for scheduling but the PCA software effort appears to be in relatively good shape. A few areas are still of concern since some SOC subsystem re-design is underway which affects the relevant PCA deliverables. At present the only PCA software activity that needs special attention to get it on track is the support to the GOF.

A review by Dr Giles of manpower estimates and the Build 3 deliverables and schedule prompted the PCA team to take on another programmer. As Software Manager Dr Giles now coordinates the work of the following programmers:

Aileen Barry	Hughes STX	GSE & INT support
Hwa-ja Rhee	Hughes STX	PCA Science Monitoring
Vikram Savkoor	Hughes STX	PCA Commanding
Ramesh Ponneganti	Hughes STX	PCA Housekeeping
Mike Stark	UofMD	Calibration & GOF support

#### **Documents:-**

The following documents have been updated or enhanced:

PCA Commands - Types, Sequences, Use, Suggested Screen Functions, Configuration Verification, SOC Interface, V2.1, October 25th 1993, A.B.Giles (42 pages)

PCA Housekeeping - Status, Suggested Screen Layout, Recall Modes, SOC Interface, V2.0, October 5th 1993, A.B.Giles (60 pages).

PCA Housekeeping Telemetry Simulator for PCA and SOC Software Testing, V2.2, October 29th 1993, A.B.Giles (27 pages)

Interface Control Document between the XTE Science Operations Center and the PCA Principal Investigator Team, XTE-SOC-PCA-ICD-V1.0, December 1993, R.Choudhary, L.Herreid, M.Lijewski, K.Hilldrup, J.Swank, B.Giles & A.Smale (50 pages)

Provisional Draft - Completed, to be signed Jan 94

#### **Publication Activities:-**

Dr Giles continues to work on the Rapid Variability Analysis paper mentioned in previous quarterly reports. A draft paper is almost complete. He has very little time available for "Science" due to relentless XTE deadlines and the increasing pressure and workload from the project office. Attempting to support XTE properly always takes more time than regular work hours.

#### **Next Quarter:-**

Dr Giles principal activity for the next 3 months will be to continue to support the SOC-PCA delivery schedule for the Build 3 plan. Documentation is due at the end of March 1994 followed by software at the end of April. He plans to complete his rapid variability analysis paper, get comments from colleagues and possibly give a seminar on it for feedback before submission to a refereed journal.

## Quarterly Report: 1 October through 31 December 1993

Weiping Zhang



### Introduction

This quarter marks the beginning of the XTE/PCA detectors evaluation, test, and calibration activities. In what follows, I will give a brief summary of my accomplishments during this period.

### Xenon Migration Problem

As I indicated in my last report, this problem was discovered earlier this year and we had spent significant amount of effort trying to resolving it. To make a long story short, finally we have determined the following: (1) the xenon permeations was through the rubber which constitutes the gasket. (2) Higher temperature baking out or the higher ambient temperature for detector operation increases the permeation rate.

The final solution to this problem is in accordance with the two findings. We decided to lower the bakeout temperature prior to the fill of each detector and we will operate the detectors at lower temperature.

### Calibration Activities

Using the beam facility on top of Building 2 at GSFC, I have checked into the uniformity of 5 of the 6 XTE/PCA proportional counters. The last one will be checked in the next few weeks. For doing the check, I developed many software tools and give necessary scientific supervision and advice to the technicians involved. In short, we verified the following: (1) Detector gain under vacuum and low temperature; (2) Detector resolution under vacuum and low temperature; (3) Collimator responses; (4) X-ray throughput directions.

Meanwhile I submitted a proposal to the PI instrument team to use the White Sands x-ray beam facility to further characterize and calibrate XTE/PCA detectors. This proposal is under review by the instrument team.

### Science Working Group Meeting

As a member of the XTE Science Working Group, I reported our progress on the PCA instruments to the SWG members on the meeting help in September at GSFC.

### The Next Quarter

To figure out why occasionally two of the six detectors would break down under cold temperature.

From: Dr. Eric R. Christian  
NASA/GSFC Mail Code 661

February 2, 1994

**Quarterly Technical Report**  
4th Quarter, 1993

ALICE (A Large Isotopic Composition Experiment): ALICE is a balloon-borne experiment designed to measure the elemental and isotopic composition of galactic cosmic rays in the charge range Silicon to Nickel between 400 and 800 MeV/nucleon. It is a collaboration with the U. of Siegen in Germany. There is an almost complete refereed paper on the isotopic composition of Silicon and Iron for submission to Astrophysical Journal. It should be submitted in the next quarter. Although I am not first author on this paper, I have been very active in the data analysis, writing and editing of this paper (and am the first US author).

Voyager Cosmic Ray System: I continue to work with Drs. Ed Stone and Alan Cummings of Caltech on a paper for the Astrophysical Journal. The data analysis for this paper is now complete, and the writing of the paper has begun, but has been delayed. Because the solar cycle is once again approaching solar minimum, Dr. Cummings and I are restarting the analysis I did for my thesis and looking for evidence of anomalous cosmic ray hydrogen.

IMAX (Isotope Matter-Antimatter eXperiment): IMAX is a balloon experiment which we are working on with Caltech, U. of Siegen, and NMSU to measure the fluxes of anti-protons, and Hydrogen and Helium isotopes over a wide energy range. During the second quarter, I have continued to work on the analysis of the data from our successful 1992 flight. I am responsible for the energy loss measurement in four scintillation counters, including mapping and other calibrations and corrections. This work will continue over this entire year. Science results are starting to appear, and some will be presented at the annual meeting of the American Physical Society next quarter, with the first refereed paper following.

TIGER (Trans-Iron Galactic Element Recorder): TIGER is a balloon experiment designed to look at ultra-heavy galactic cosmic rays. It is an collaboration with Washington U. (St. Louis) and U. of Minnesota. Last quarter, I led the calibration and refurbishment of the two detectors we are supplying. That is now finished, and we should be shipping them to Wash. U. for integration in the experiment for a launch this summer.

ISOMAX: This is another magnetic spectrometer balloon experiment in collaboration with Caltech and U. of Siegen. It is specifically designed to look at the isotopic composition of Beryllium, because  $^{10}\text{Be}$  is a very important clock that can measure the lifetime of all cosmic rays. Because  $^{10}\text{Be}$  is a rare isotope, the experiment is being designed for long duration flights from Antarctica or Greenland, although the first flight in 1995 is planned for Canada. I am responsible for the onboard command and data handling system and the ground support equipment. During this quarter, I the data system design was completed, and we are now beginning construction.

ACE (Advanced Composition Explorer): ACE is an Explorer that is planned for launch in 1997 to study the solar wind, and heliospheric and low energy galactic cosmic rays. I am the Assistant to the Project Scientist (Jon Ormes) in much the same way as I was working on the defunct ASTROMAG. This requires spending considerable amount of time in meetings and facilitating communication between the project management here at Goddard, the spacecraft contractor (the Applied Physics Laboratory), and the experiment teams. I am also on the science team for two of the instruments onboard. During this quarter, the amount of time I've spent working on ACE has increased, and this will continue into the next quarter. I am a member the ACE Mission Operations Working Group and the Spacecraft Operations Working Group, both of which meet monthly. I also attend weekly project meetings and the monthly APL status meeting. During the last quarter, we got approved for Phase C/D (yeah!), the Project Data Management Plan and Logo that I was working on were both approved, and the mission Preliminary Design Review was held successfully. During the next quarter the most important things will be the PDRs for the instruments (especially the two: CRIS and SIS, that I am on), and the public relations brochure.

I have also been working with Drs. Dan Baker (NASA/GSFC) and John Cooper (NSSDC) on some theoretical work on solar modulation. We are attempting to gain insight into modulation processes by treating the heliosphere in the same way planetary magnetospheres are treated (which are their specialty). During the last quarter, John and I submitted an abstract to an April Ulysses conference that, if approved, will end up as a refereed paper. I am first author on this paper.

On top of all this, I am the system manager for the new UNIX computer system the group has bought for use in IMAX and ISOMAX data analysis. As part of this, I am giving a series of lectures to the group on the new software and environment.

TO: David Holdridge/610.3, USRA  
FROM: Scott Barthelmy/661  
RE: 4th Quarter 1993 Report

17 Jan 1994

This report describes 4 areas of activities: the Gamma Ray Imaging Spectrometer (GRIS), the BACODINE project, the Gamma ray To Optical Transient Experiment (GTOTE), and several miscellaneous activities. My effort was split approximately 10/70/10/10. The activities described below are mine either directly or through the supervision of others. For the GRIS project there one other scientist whose efforts are in other areas and are not described here. There are no other scientists contributing on the BACODINE or GTOTE projects.

#### **GRIS project activities:**

After the usual "decompression" period after a GRIS field-ops, I got into starting the post-flight data analysis. This has greatly improved now that we have a reliable on-board tape recorder (due to E.Eng. Bob Smith & myself). A lot of effort was put into preparing the instrument state-of-health data from the flight to be used by the SAGE team (the U. of Birmingham, England, piggy-back instrument).

Mods are being designed & implemented for the next flight (Fall 94). They include (1) a new wide-field-of-view shield crystal assembly (replacing the narrow FOV assembly, which will be used for a measurement of the cosmic gamma ray background spectrum measurement and (2) a blocking crystal assembly to do the galactic plane 511 line emission distribution. I supervise three people in the above activities. In addition we will be flying another piggy-back instrument. This one (a new gamma-ray detector technology instrument) is being developed within our group (Neil Gehrels & Ann Parsons).

I was appointed "Lead Instrument Scientist" for the GRIS project. This is a result of the PI-ship being transferred from B. Teegarden to J. Tueller. This is equivalent to "Project Scientist", but because I am not a civil servant that term can not legally be used. Attached is the appointment letter from B. Teegarden. (For some reason I neglected to include this appointment in the previous quarterly report.)

#### **BACODINE project activities:**

The BACODINE project has exploded in scope from its original idea. It turns out many people are interested in receiving the real-time GRB coordinate locations.

Currently three instrument are receiving BACODINE burst reports. A group at Lawrence Livermore National Labs has an instrument with 23 CCD cameras covering a 60° FOV on a fast moving Az-El mount with a sensitivity of 8-9 mag. Dr. Tony Beasley of NOAO has large allotments of VLBA time, which we have been making rapid (~5min) follow-up observations using BACODINE positions. And here at GSFC, the satellite tracking and laser ranging people have an image intensified TV camera and recorder on a fast moving Az-El mount. In addition to those 3 collaboration efforts, I am setting up collaborations with Dr. George Ricker of MIT (using their ETC instrument at Kitt Peak), Dr. Kevin Hurley of UC Berkeley (using the Lick Observatory astrophotograph), Dr. Bernie McNamara of UNM (using 3 Air Force satellite

tracking cameras), Dr. Holger Pederson of U. of Copenhagen (using the ESO Schmidt in Chile), Dr. Steve Thorsett of CalTech (using a phased array radio telescope near San Diego), Dr. Jim Kurfess of NRL (using the OSSE instrument on GRO), and Dr. V. Schonfelder of MPI Garching & Dr. J. Ryan of UNH (using the COMPTEL instrument on GRO). Several other groups have expressed interest in setting up collaborations.

The so called "level 1" version of the coordinates calculation algorithm is implemented and functioning routinely. The U. of Maryland physics grad student, James Kuyper, is continuing his summer work this Fall semester and will continue during the next Spring semester. He will finish the implementation of the code which corrects the position determination for the non-cosine(theta) detector dependencies and the earth atmosphere scattering correction.

#### **GTOTE project activities:**

This has been progressing at a low level of effort given the GRIS balloon flight campaign and the near explosion in effort, interactions, and activity on the BACODINE project. The mount for the camera was delivered in October. The weather enclosure is under construction (80% done) at the GSFC Optical Test Site.

#### **GRB Follow-up Proposals:**

My ToO proposal on the Kitt Peak Schmidt for renewal (Feb-Aug 94 semester) was accepted. The companion proposal for the CTIO Schmidt (Brad Schaefer PI and I Co-I) was also accepted. Both proposals have the goal of making rapid response follow-up observations on GRBs.

#### **Talks:**

At the Oct.93 GRB conference in Huntsville, I gave a talk on the BACODINE system. I also presented a poster paper on results of rapid follow-up observations on 3 recent gamma ray burst error boxes. In November I combined both of these talks into a single talk for the Washington Area Astronomers meeting. Then in December I had my "Recent Results" poster paper presented at the Goddard Atrium Tea & Posters.

#### **Misc:**

Brad Schaefer and I petitioned to make a ToO observation of the Soft Gamma Ray Repeater (SGR) 1806-20 during its recent renewed outburst phase using the OSSE instrument to see if we could detect fainter bursts. The GRO observing schedule was changed to swap two observing periods so that the SGR could be observed sooner. During the 2 weeks of observation (with spacecraft 25% duty cycle) we saw no bursts.

Reply to Attn of: 661

July 6, 1993

MEMORANDUM FOR RECORD

FROM: 661/Dr. Teegarden

SUBJECT: Appointment of new PI for the GRIS Program

This memorandum is to record the appointment of Dr. Jack Tueller as the Principal Investigator of the Gamma-Ray Imaging Spectrometer (GRIS) balloon program. My responsibilities and duties in other areas prevent me from continuing in this role. I will continue my association with GRIS in the role of co-investigator. Dr. Tueller has been a key scientist in the program nearly from its inception. He deserves a major share of the credit for the scientific and technological success that GRIS has enjoyed. He is thoroughly knowledgeable of all aspects of the program and is imminently qualified to lead it. It is anticipated that there will be an active program of balloon flights for at least the next two years and that the program will be re-proposed for the next 3-year SRT cycle. These flights will combine science objectives with technology development for new space missions such as INTEGRAL.

In addition I would like to appoint Dr. Scott Barthelmy as the Lead Instrument Scientist for the GRIS program. Like Dr. Tueller, Dr. Barthelmy has been a key member of the GRIS team throughout most of the program. This appointment is an appropriate recognition of the many years of dedicated effort that he has invested in the GRIS program.

*Bonnard J. Teegarden*

Bonnard J. Teegarden

Approval:

*Jonathan F. Ormes*  
Jonathan F. Ormes  
Chief, LHEA

*Stephen S. Holt*  
Stephen S. Holt  
Director, Space Sciences

cc:  
HQ/SZ/Dr. Kaluzienski  
661/Dr. Tueller  
661/Dr. Barthelmy  
661/Dr. Cline

*13538*

# USRA Technical Report (4th Quarter, 1993)

Helmut Seifert (Task Number: 660-044)

## Task Description:

I have been leading the Transient Gamma-Ray Spectrometer (TGRS) data analysis and Ground Support Equipment software development, and am responsible for writing the software requirements/specifications and documentation. I am furthermore designing and testing the algorithms which are being used by the software. Similar work is done by me also for the KONUS instrument. I am taking an active part in the laboratory testing of the TGRS analog/digital flight electronics and software. I am responsible for formulating and conducting all the instrument tests and calibrations during the integration and calibration phase of TGRS.

## Activities:

From 25 September–3 October 1993 I was at Martin-Marietta (former GE Astro) in East Windsor, NJ, to support the GGS/WIND Thermal Vacuum Test which had been in progress since the beginning of September. On 5 and 6 October I supported the final Mission Profile Test (MPT) from the POCC at NASA/GSFC.

From 17–19 October 1993 I returned to Martin-Marietta, together with our Analog Electronics Engineer, to pick up the TGRS instrument for refurbishment. At this time we also performed several tests of our instrument on the spacecraft to characterize and investigate a noise problem which we had identified during the Thermal Vacuum Test. In particular we tried various shielding schemes on the cooler and front-end electronics to eliminate the noise. We found that the noise was not of radiative nature.

Upon return to GSFC we set up the detector/cooler in our Operational Test Fixture (OTF) and started to cool down. Before this we also recharacterized the warm detector/cooler assembly on the bench; this test however was not very conclusive since the conditions were very different from the spacecraft.

The whole month of November 1993 was used for refurbishment and final calibration of our instrument. Some parts in the Analog Processing Unit (APU) were exchanged, and the grounding in the APU box was improved. A pole-zero adjustment was done. The APU was then vibrated, temperature-cycled and retested. To address the noise problem the grounding and shielding on the cooler

were improved. The optical tape on the top surface of the detector module had to be reinstalled since it had come off after a cool-down. Finally, an electrostatic wire grid was installed over the cooler opening.

Some of the instrument flight harnesses were reworked to address the noise problem (essentially we installed filters at the appropriate places in the harnesses, temperature sensor and heater wires). We also investigated the question whether to electrically isolate the cooler from the spacecraft structure (was not done).

The final calibrations included Integral and Differential Nonlinearity (INL and DNL) runs, efficiency runs with radioactive sources, and calibrations of the discriminator thresholds (with pulser and sources).

From 15–16 December 1993 our Analog Electronics Engineer and I delivered the complete TGRS detector/cooler assembly to Martin-Marietta, and performed another noise test.

The first quarter in 1994 will be mostly spend with data analysis software development and preparations for the flight operations. There will be electrical integration of the TGRS instrument on the spacecraft and some tests of yet undetermined scope at Martin-Marietta. The WIND launch has been tentatively shifted to July 1994.

UNIVERSITIES SPACE RESEARCH ASSOCIATION  
GODDARD VISITING SCIENTIST PROGRAM

QUARTERLY TECHNICAL REPORT- Fourth quarter of 1993 - 1/31/94

Employee Name: John W. Mitchell    Task Number: 660-018

During the past quarter my primary activities were development work for the new ISOMAX balloon program, analysis of the 1992 IMAX flight, preparations for the WiZard 1994 balloon campaign, and an experimental run of the E878 experiment. During the past quarter I also worked on a number of new and ongoing projects. These are described below.

ISOMAX - Isotope Magnet Experiment: In this program a new balloon-borne cosmic ray instrument is being developed by GSFC (lead institution), Caltech and the University of Siegen. Initially this program will be directed toward measurements of the isotopic abundances of beryllium and other cosmic ray constituents between lithium and oxygen. I am Instrument Manager for ISOMAX. In this capacity, during the last quarter, I worked on a variety of experiment issues.

The instrument is based on a new large superconducting magnet. I am responsible for the magnet, and during the past quarter I completed final preparation of the RFP for its construction. This required evaluation of a number of the engineering design parameters. The RFP has been reviewed and was let out for bids on 1/7/94.

I am also responsible for the time-of-flight system and the experiment electronics, including development of new low-power flight systems. During the past quarter I worked on hardware for the low power electronics. I also worked on conceptual development of the time-of-flight system.

Also, during the past quarter I began the detailed instrument layout in preparation for working out the payload structure.

ISOMAX activities will occupy most of my time during the next quarter.

IMAX (Isotope Matter-Antimatter eXperiment) - This instrument was the product of a NASA/GSFC led collaboration, which includes New Mexico State University, the California Institute of Technology, and the University of Siegen (Germany). Among other responsibilities, I was the Instrument Manager for this program and had the lead role in carrying out the development of the instrument. I am continuing in this role during the analysis phase of the project.

I am working directly with two graduate students, Wolfgang Menn and Olaf Reimer, at the University of Siegen, Germany, analyzing the IMAX TOF and aerogel Cherenkov detectors. This work will continue during the next quarter.

A week-long IMAX collaboration meeting was held at GSFC in November, 1993. At this meeting the state of the analysis was reviewed and plans were made for the next phase. It was decided that the He isotope analysis was sufficiently well developed to submit an abstract for the spring meeting of the American Physical Society.

Also during the past quarter, an article on the IMAX tracking system was prepared for submission to Nuclear Instruments and Methods. This article was primarily written by the University of Siegen group. I reviewed and edited the article.

In December, 1993, I gave a colloquium at GSFC on the initial results from IMAX.

MASS/WiZard: The new WiZard-Related Balloon Program is a series of experimental investigations of cosmic ray antiproton and positron spectra using the NMSU balloon-borne magnet spectrometer payload. During the past quarter I participated in preparations for a flight to take place in summer, 1994. My efforts centered on the time-of-flight system and on the electronics.

SMILI (Superconducting Magnet Instrument for Light Isotopes): The SMILI instrument flew twice: in August, 1989, and in August, 1991. During the past quarter analysis continued on data from both flights.

E878 (ANTI): This is a program of experiments at the Brookhaven National Laboratory Alternating Gradient Synchrotron (AGS) to obtain the heavy-ion-collision production spectrum of pions, kaons and antiprotons in the energy range from 1.5 GeV to 24 GeV. E878 will also conduct a high statistics search for the production of antideuterons or exotic particles in this energy range.

E878 conducted its first experimental run in spring, 1992. An extremely successful second experimental run was carried out between 8/1/93 and 10/14/93. I worked on both the experiment set-up and the run. I was responsible for the Cherenkov detectors (gas and aerogel) and shared responsibility for the experiment electronics. In addition, I acted as shift leader and was responsible for post-run calibration of the electronics and the Cherenkov detectors.

I designed and built the aerogel Cherenkov detectors. These were extremely successful and performed at least as well as any similar detectors described in the literature.

During the past quarter, analysis of the data from this run began. I am an active participant in this process. The primary activity during the past quarter was aimed at organizing the analysis effort and defining the initial data to be analyzed to calibrate each detector system.

In 10/93, two papers reporting the quick-look results from the 1993 run of E878 were presented at the fall meeting of the Division of Nuclear Physics of the American Physical Society.

A description of the strange particle (strangelet) search was published in the January, 1994 issue of Scientific American (H. J. Crawford and C. H. Greiner, "The Search for Strange Matter"). The lead photograph in this article features the E878 Cherenkov detectors.

Experiments E683H and E849H: These experiments were performed in the Beam 40 Zero Degree Spectrometer Facility at the Lawrence Berkeley Laboratory Bevalac heavy ion accelerator, using a solid state detector telescope and a dE vs. total E method of particle mass identification. The results from E683H are now being prepared for publication. The publication has reached a near-final draft stage and it is expected that it will be submitted to the Physical Review during the next quarter.

Experiment E938H (Transport Collaboration): This is an LBL HISS (Heavy Ion Spectrometer System) based experiment, directed toward obtaining information on the energy dependence of the reaction cross sections of a variety of nuclear species of astrophysical importance, incident on a liquid H target (simulating the ISM).

During the past quarter, I participated in the analysis effort and in other collaboration activities. In particular, I directed a post-doctoral researcher from the University of Catania, Sicily, Jan Romanski, in improving the calculations of the particle flight times. I also worked on modeling the instrument acceptance as one of the final steps in preparing for an initial publication. The Monte Carlo code that I developed for the acceptance calculations has proven to be extremely successful and versatile. Work will continue in both of these areas during the next quarter.

An E938H paper giving the results on charge-changing cross sections was submitted to the Physical Review during the past quarter. Three additional papers are in preparation. It is expected that at least one of these will be submitted during the next quarter.

TIGER - Trans-Iron Galactic Element Recorder: This is an experiment to measure the elemental composition of galactic cosmic rays in the charge range above iron. This experiment relies on a precision time-of-flight (TOF) system and a Cherenkov detector system to measure the velocity of the incident particles, and on a pair of scintillators to measure ionization energy loss. GSFC will be supplying the Cherenkov detector and one of the scintillators and will have an active role in the development of the TOF system. The first flight of TIGER is planned for summer, 1994.

During the past quarter, I worked on TOF system development and testing as well as in general experiment planning. I also worked on the experiment electronics and structure. During the past quarter, a test of the TOF system was carried out at Michigan State University. I helped plan this test and participated as a remote consultant during the actual run.

H0: During the past quarter I participated in preparing a proposal for a new accelerator experiment which will conduct a high sensitivity search for the H0 hyperon. This is a six quark bag (uuddss) that is predicted to be produced in great numbers in heavy-ion central collisions. However, it has a short lifetime and has not been detected as yet. The proposed experiment will conduct the most sensitive search to date for this particle. The experiment was initially proposed to the Program Advisory Committee (PAC) of the Brookhaven National Laboratory Alternating Gradient Synchrotron on 10/14/93. While not approved, the response to the proposal was good. During the past quarter I worked on improving the proposal. The H0 experiment will be presented to the PAC again in spring, 1994.

If it is accepted, I will have responsibility for the experiment's fast event trigger and for the high-rate beam detector system.

I will also participate in the development of a second level (software or hardware) trigger. This will be an extremely complex system capable of performing pattern recognition on a 10,000 cell drift chamber tracking system (DDC). A complete accept/reject trigger decision must be made in less than 100  $\mu$ s and it is expected that the trigger will incorporate a massively parallel architecture. This architecture may form the basis for the trigger to be used in an upcoming experiment at the new BNL Relativistic Heavy-Ion Collider (RHIC). My particular interest in the second level trigger is in developing fast (few  $\mu$ s decision time) hardware-based pattern recognition techniques.

In addition, I will have a part in development of the critical Distributed Drift Chamber (DDC).

POEMS (Positron Electron Magnet Spectrometer) - This is an experiment to measure the cosmic ray electron and positron flux, using a magnetic spectrometer technique. POEMS was accepted for phase B development as a Small Explorer. The silicon strip detector

hodoscopes are to be built by GSFC. During the past quarter, I participated in a number of POEMS collaboration activities.

New Satellite Experiments: During the past quarter I worked on the conceptual development of three new experiments which may be proposed in response to the upcoming USRA satellite AO or the new Fast Sat program. These experiments will be closely tied to university collaborations.

In addition, I worked on the development of three possible satellite experiments to be performed by international collaborations.

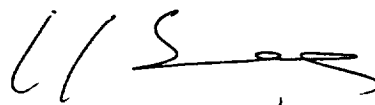
Next-generation High-energy Gamma Ray Telescope: The high-energy gamma ray group at GSFC is in the process of developing a drift-chamber based tracking system to be used as a part of the next generation of high-energy gamma ray telescope. I have been acting as a consultant on this effort.

To: USRA/Ms. Crystal C. Wheatley  
From: Yang Soong, LHEA Code 666, Bldg. 2, Rm 271, X66318  
Date: Jan 31, 1994  
Subject: Technical Report for 10/1-12/31, 1993

The proposal for the center DDF funding was submitted and was granted for a one year extension of the original proposal of fabricating X-ray reflecting mirrors via surface replication. This lab expects to apply this technique for future X-ray imaging project in order to improve the spatial resolution. Another proposal for lab development in the next three years to the NASA/HQ was also submitted and we are waiting to be reviewed in January '94. I was Co-I in both of the proposals.

ASCA data analysis is underway. We are sharing the PV phase data among the PI groups. I am working on the Galactic binary X-ray emitters.

These activities have been supported by the task # 5030-14A-39.

  
Feb 3, 94

QUARTERLY REPORT TO USRA FOR THE PERIOD  
1st October 1993 – 31st December 1993

Tahir Yaqoob

TASK No. 93-15-00; EMPLOYEE ID: 05-05 96800

Following is an outline of accomplishments this period. I will deal with each project in turn.

**Published & Accepted Papers**

The papers *A BBXRT Observation of the High Luminosity Quasar H1821+643* and *The Fe K Line As A Probe Of Beamed X-ray Emission In AGN* were published in the *Astrophysical Journal*.

**Analysis of ASCA Data**

The Performance & Verification phase (PV) of the Japanese/US X-ray astronomy satellite, *ASCA*, began in March 1993 and has been producing a large quantity of new data. I have begun to analyse data from many observations but below will describe below some of the projects which have received the most attention.

(i) *ASCA Observations Of The Two High Redshift Quasars PKS 0438-436 & PKS 2126-158*

Quasars are amongst the most luminous objects in the Universe and the two mentioned here are amongst the furthest known. Their enormous energy output still remains a mystery as well as the evolutionary properties since these objects exist when the Universe was only 25% of its present age. *ASCA* obtained the most sensitive X-ray spectral measurements of these quasars to date and the results are extremely interesting. Their spectrum appears to be different to quasars which are closer and it may be that they are actually a different class of object. The lack of detection of iron-line emission by *ASCA* strongly rules out certain theoretical models of the central engine. This is also a new result. A paper describing the results was completed and submitted to the *Publications of the Astronomical Society of Japan*

(ii) *The X-ray Emission of 3C 273 Observed with ASCA*

The high luminosity quasar 3C 273 was observed with *ASCA* in the PV phase and revealed a very interesting spectrum compared with previous measurements by the *ROSAT* and *Ginga* satellites. The observations clearly show two independent components in the X-ray spectrum (a soft component and a hard component) which have different variability properties. A paper was completed and submitted to the *Publications of the Astronomical Society of Japan* discussing the results and implications. 3C 273 has also been adopted as a calibration target by one of the *ASCA* instrument teams and the current uncertainties and systematics in the instrumental responses which the above data show were also detailed in the paper.

(iii) *ASCA Observation of the Seyfert II Galaxy MKN 3*

An *ASCA* observation of this type II Seyfert galaxy revealed remarkable interesting new information. Seyfert II galaxies are active galactic nuclei (AGN) which are thought to be Seyfert type I galaxies which are obscured by thick material in the line-of-sight. The central engine is thought to be essentially the same in both types of AGN. The Seyfert IIs have prominent Fe K emission lines with large equivalent width and are thought to be produced in an extended warm scattering zone. However, *ASCA* data shows that the line intensity is variable when compared with data from previous satellites and this is *not* expected if the line is produced in an extended region. Instead, the line must be produced at a site closer to the nucleus and this is an unexpected result. A paper describing the results of analysis of *ASCA* data for MKN 3 was written and submitted to the *Publications of the Astronomical Society of Japan*.

### **IDL Analysis Tools**

More routines to facilitate and advance the analysis of *ASCA* data were written in IDL.

### **WORK PLANNED FOR NEXT QUARTER**

In the next quarter the analysis of *ASCA* PV data will continue, for the sources mentioned here and new targets. Proposals will be written to gain observing time from the AO-2 phase of *ASCA*.

## Technical report for Michael Loewenstein, 10/1/93-12/31/93

My paper entitled "Implications for Gravitational Lensing and the Dark Matter Content in Clusters of Galaxies from Spatially Resolved X-ray Spectra", submitted to the *Astrophysical Journal* last quarter, was revised in accordance with the comments of an anonymous referee and was resubmitted.

With the cancellation of AXAF-S, there are efforts underway to place the x-ray microcalorimeter, developed at GSFC, on board the next Japanese x-ray satellite, Astro-E. Dr. R. Mushotzky attended a meeting at ISAS in December to discuss the various alternatives, and I spent a great deal of time and effort working up feasibility studies and simulations prior to the meeting. This seems to have paid off as the Japanese were very receptive to the possibility of using the microcalorimeter aboard Astro-E.

I am continuing to analyze ROSAT observations of low luminosity early type galaxies as part of a project in conjunction with Dr. R. Petre to study these objects in x-rays. Preliminary results on the galaxies in the NGC 3607 group were presented at the ROSAT Science Symposium in November. These results, augmented by preliminary analysis of the galaxy NGC 4697, will be presented at the AAS meeting in Washington D.C. in January and at the "New Horizon of X-ray Astronomy" meeting in Tokyo in March. We plan to submit ASCA AO-2 and ROSAT AO-5 proposals to extend this study.

I am a co-author (with Dr. Mushotzky of NASA/GSFC, and Drs. H. Awaki and T. Tsuru of Kyoto University) on a first round ASCA paper (to be published in the *Proceedings of the Astronomical Society of Japan*) describing the results of PV-phase observations of three elliptical galaxies (NGC 4406, NGC 4472, and NGC 4646). We have obtained the most accurate temperatures and abundances in elliptical galaxy hot ISMs to date, and derive implications for the gas heating and dark matter content in these galaxies. I hope to work further on PV-phase data in the coming quarter.

## MEMORANDUM

TO: Crystal Wheatley  
FROM: Kevin Black  
DATE: December 15, 1993  
RE: Final Technical Report through December 15, 1993  
(Task # 660-031)

A major milestone in the MOXE project was recently met as the MOXE engineering model was delivered to and passed acceptance testing by the Space Research Institute (IKI) of the Russian Academy of Sciences. Most of my time was spent preparing for these tests and in actual delivery and testing.

Preparation included working closely with the GSE programmer to develop appropriate data displays and analysis tools, preparing test plans, and preparing documentation. I prepared the MOXE instrument technical description document and prepared test procedures for interface tests with the Spectrum-X-Gamma spacecraft simulator and the on-board computer.

I led the group from Goddard that delivered the MOXE engineering model to IKI for acceptance testing. The engineering model will be integrated in Russia with other instruments and an engineering model spacecraft for functional validation of the Spectrum-X-Gamma design. The MOXE engineering model was accepted by the Spectrum-X-Gamma program. Acceptance came on December 3 at the end of a week-long series of tests at IKI in Moscow. The MOXE engineering model passed its tests without major anomaly. MOXE is now the second western engineering model delivered to IKI, and follows closely on the heels of the United Kingdom's JET-X x-ray telescope.

The MOXE engineering model instrument, GSE, and other support equipment were delivered as diplomatic baggage to the US Embassy in Moscow. On the first day, the Goddard team (with Russian support) picked up the equipment from the embassy and took it to IKI. By the end of the first day, the instrument was set up, but not functioning completely because of minor damage in shipping. On the second day, all damage was repaired and the instrument was completely functional.

The series of tests included a visual inspection, an isolation test, and an autonomous test and a test with the Russian "SKAI", a spacecraft simulator, and the Hungarian "BIUS", the on-board computer. During the test with SKAI and BIUS, all electrical interfaces to MOXE were successfully tested and acceptance testing was complete. After this, a joint test with MOXE and JET-X was successfully conducted.

## Report of activity for the period September - December 1993 - Ivan HUBENY

During this period, I have continued my work on non-LTE model stellar atmospheres including effect of millions spectral lines (the so-called non-LTE line blanketing), mostly in collaboration with Dr. T. Lanz. We have performed a number of tests of the new version of my computer program TLUSTY for calculating non-LTE models stellar atmospheres which was upgarded by the so-called "fully hybrid complete-linearization/accelerated Lambda iteration (CL/ALI) scheme". Several papers describing the method and some results are expected to be submitted soon.

I have collaborated with Dr. A. Linnell (University of Washington, Seattle) on developing an universal spectrum synthesis program for binary stars. The first paper is going to be submitted within several days.

I have continued on a long-term project of developing a comprehensive computer program for line formation taking into account the effects of partial frequency redistribution (together with Dr. B. Lites of HAO NCAR in Boulder, CO). During my stay in Boulder, I have debugged the first step (static atmospheres). The results are going to be published soon.

I have collaborated with researchers from Space Telescope Science Institute, (Drs. K. Long, F.H. Cheng), Johns Hopkins University, and Pennsylvania State University (Dr. R. Wade) on models of accretion disks and white dwarfs found in some selected cataclysmic binary systems (those observed by Hubble Space Telescope and Hopkins Ultraviolet Telescope).

### *Trips accomplished:*

i) October 7 - 14, University of Washington, Seattle: Collaboration with Dr. A. Linnell on spectrum synthesis for close binary stars.

ii) October 19 - 25, High Altitude Observatory, NCAR, and JILA, University of Colorado, Boulder: collaboration with Dr. B. Lites on radiative transfer with partial frequency redistribution, and with Dr. P. Bennett on model atmospheres for B stars.

### *Papers submitted:*

Hubeny, I., 1993, "Vertical Structure and Theoretical Spectra of Accretion Disks" in *Interacting Binary Stars*, (ed. by A. Shafter), ASP Conf. Series (submitted).

Long, K.S., Wade, R.A., Blair, W.P., Davidsen, A.F., Hubeny, I., 1993 "Observations of the bright novalike variable IX Vel with the Hopkins Ultraviolet Telescope", *Astrophys. J.* (in press).

Hubeny, I., Harmanec, P., Shore, S.N., 1993 "On the strategy of future observations and modeling of the  $\beta$  Lyrae system", *Astron. Astrophys.* (submitted).

### *My plans for the next three months include*

i) I will continue the work on NLTE line blanketed model atmospheres, in collaboration with Dr. T. Lanz.

ii) I will continue my work in theoretical analysis of hot stars, in collaboration with Drs. Sally Heap and GHRS group in Goddard. In particular, the work will continue on interpreting the HST/GHRS spectra of the hot subdwarfs BD+75 325 and BD+28 4811, and O stars  $\xi$  Per and 10 Lac.

iii) I will continue to collaborate with Dr. A. Linnell on testing a universal computer program for spectrum synthesis for binary stars.

iv) I will collaborate with Dr. M. Plavec (UCLA) on model atmospheres and accretion disks for selected symbiotic systems and cataclysmic variables.

v) I have started a series of about 13 lectures entitled "GHRS Short Course on Stellar Atmospheres" for all interested employees of Goddard (Codes 680 and 660). The lectures met with a large interest, and enjoy a large attendance.

### *My travel plans include:*

i) January 12 - 15, Washington, DC, 183rd meeting of AAS.

ii) January 27 - February 4, University of California, Los Angeles, Collaboration with Dr. M. Plavec on model atmospheres and accretion disks for selected symbiotic systems and cataclysmic variables.

Other activities included preparing and giving a presentation on MOXE for the Director of Goddard during his tour of LHEA. I also made this presentation to a reporter from "Space News".

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